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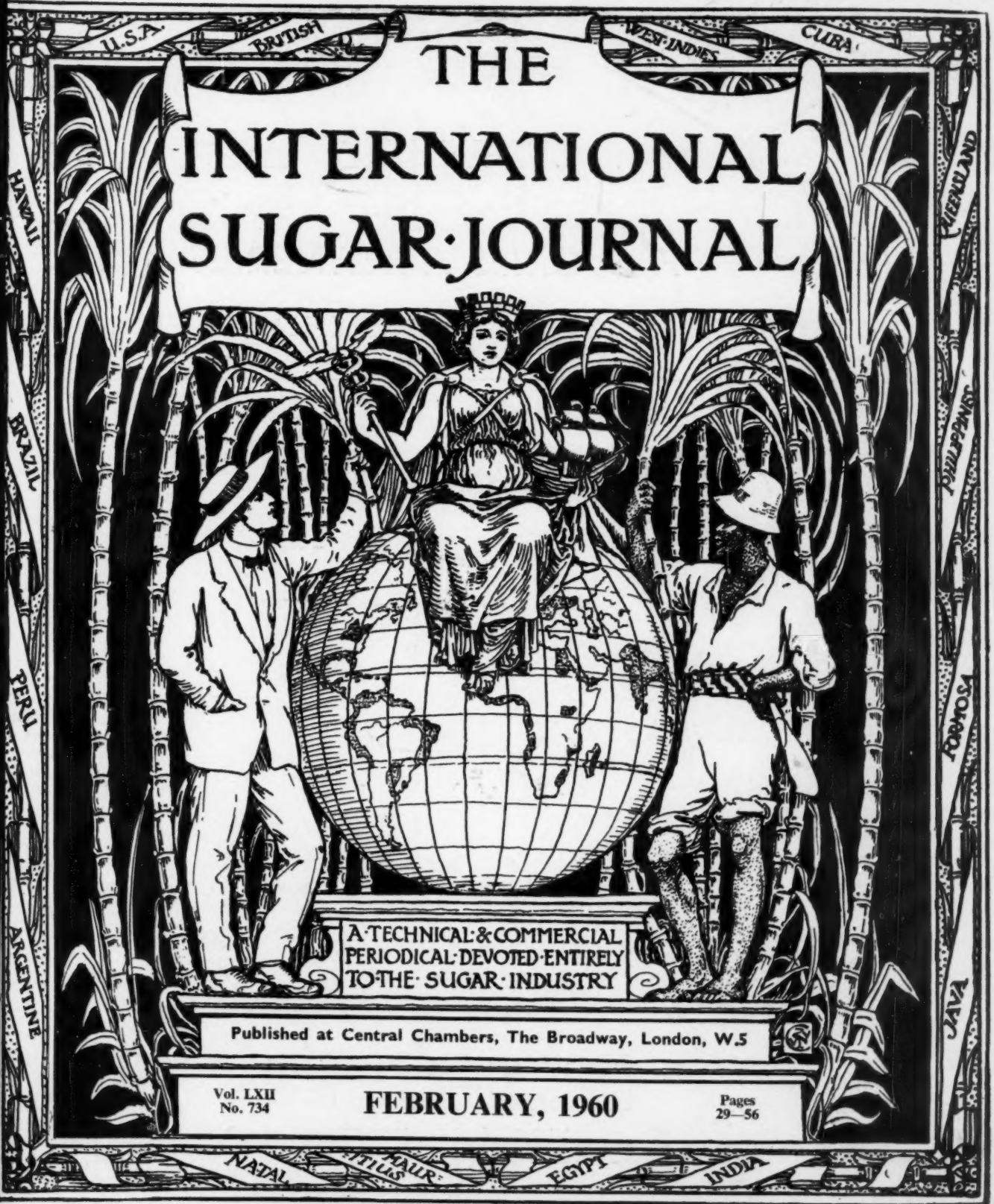

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FEBRUARY, 1960

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29—56

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BLAIRS

COMPLETE

SUGAR

FACTORIES & REFINERIES

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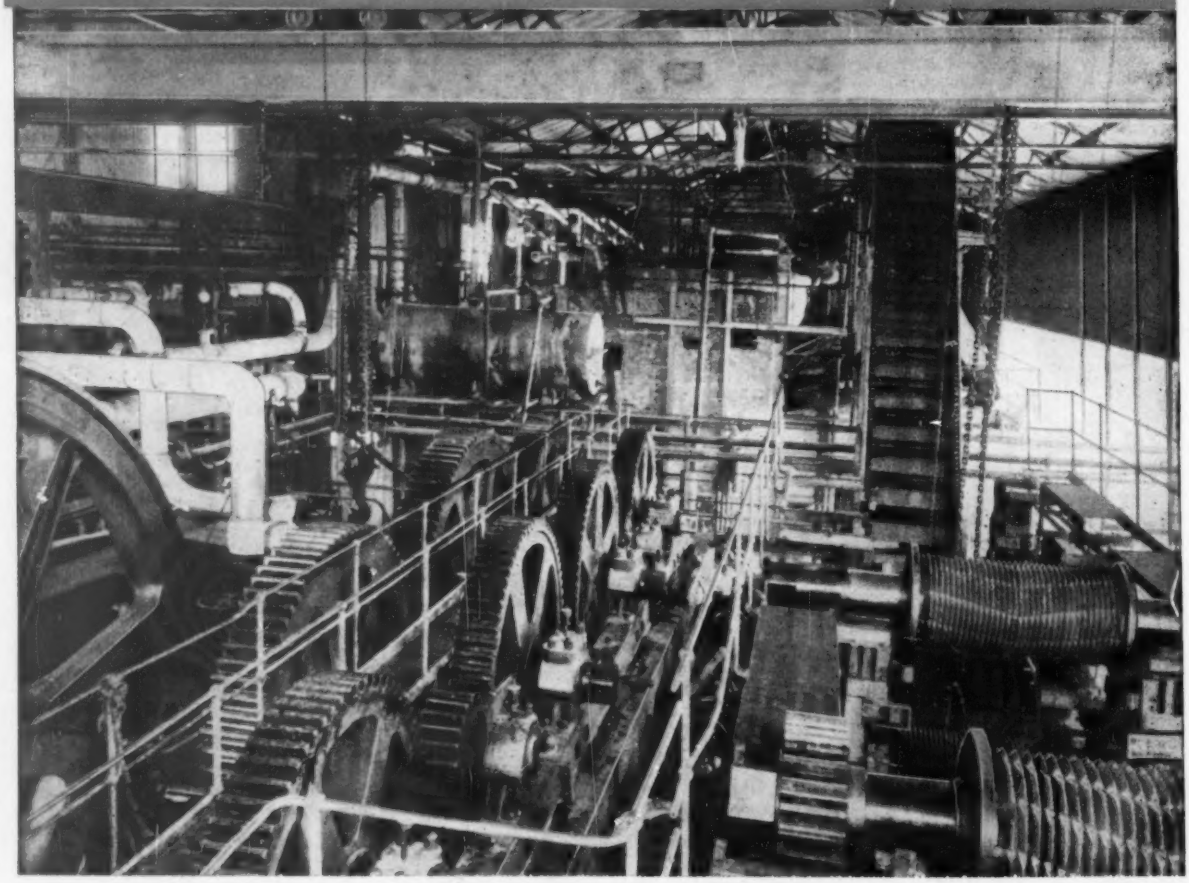

A photograph showing part of a Mill House of a Factory in Jamaica. It will be noted it was taken during off-season inspection.

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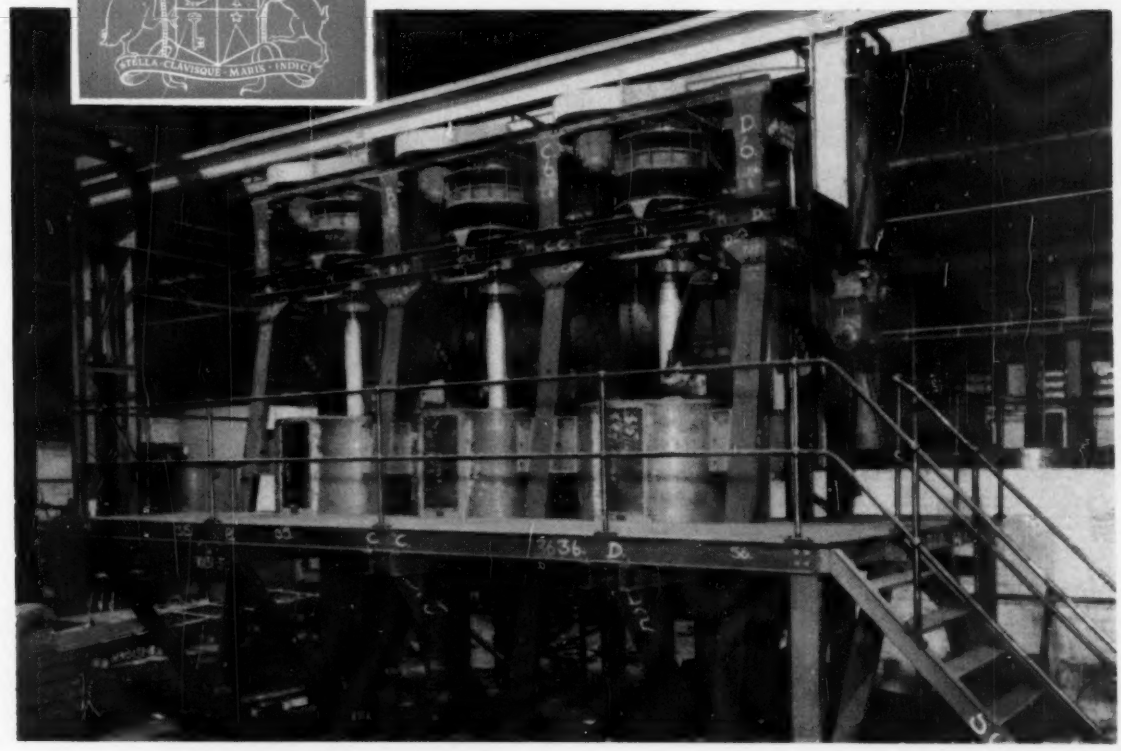

FOR MAURITIUS . . .

A battery of 48 in. × 30 in. 1200 R.P.M. automatic ploughing centrifugals photographed during erection at our works for the Labourdonnais factory.

Broadbent centrifugals have been supplied to the following factories in Mauritius since 1952 :—

Beau Vallon	Medine, Reunion	St Antoine	Benares
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Britannia	Riche en Eau	Union St. Aubin	Highlands
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A TOTAL OF 93 CENTRIFUGALS

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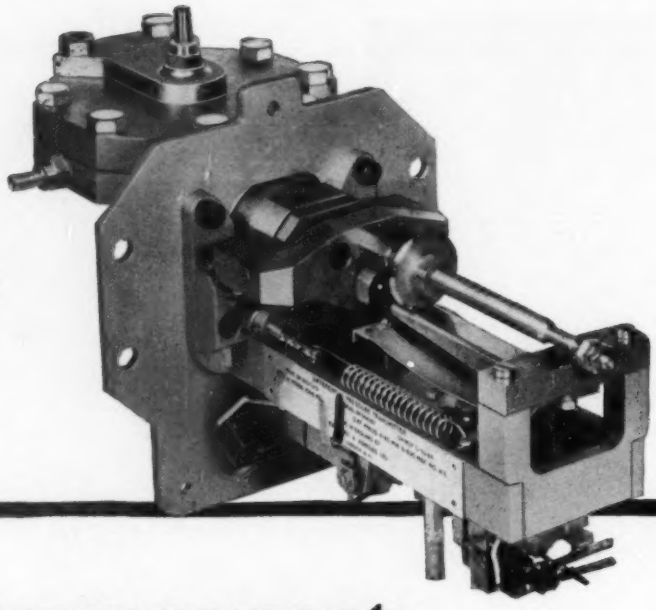
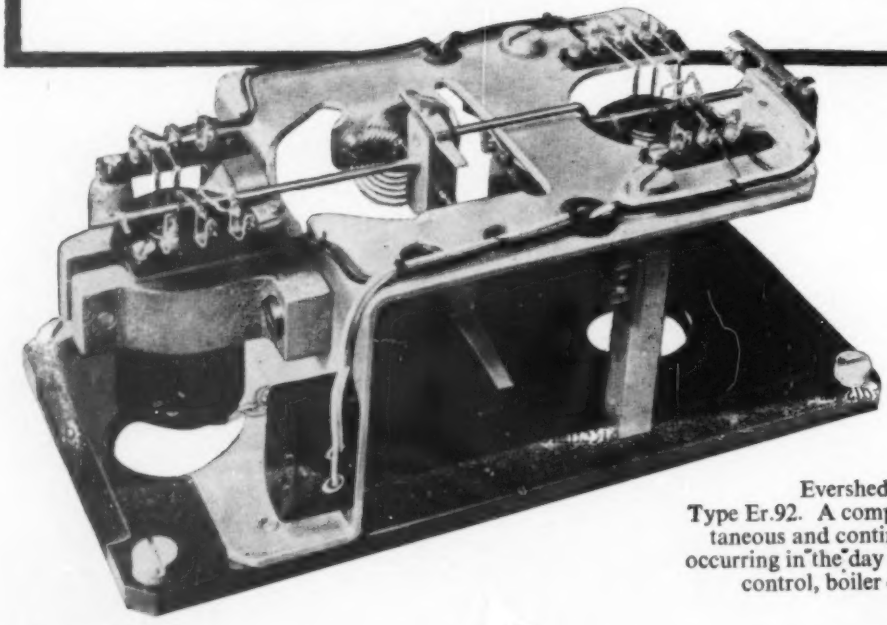


Evershed flow or differential pressure transmitted, Type ER.125 designed for accurate measurement and to give reliable service under the most exacting conditions. Suitable for oil, viscous or corrosive fluids, water, steam or gases.

Where measurements matter most — You will find EVERSHED instruments



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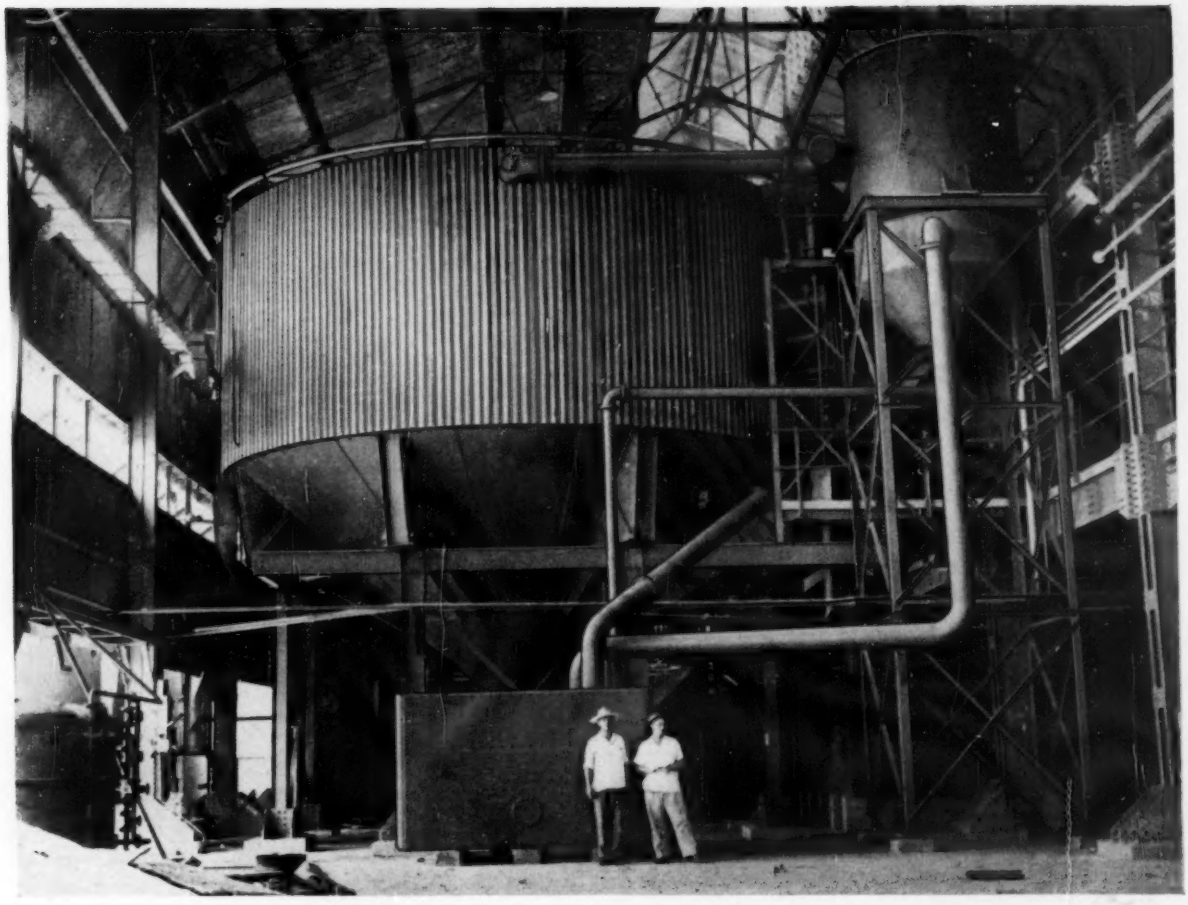

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BACH CONTINUOUS SUBSIDERS

Illustrated is one of our most recent installations, a 30 feet, 5 tray Subsider in operation in Venezuela.

This Subsider enables juice to be drawn off at 5 points of optimum clarity. Surface evaporation is obviated, no surface scum enters the tank, and a high temperature is maintained throughout the apparatus.

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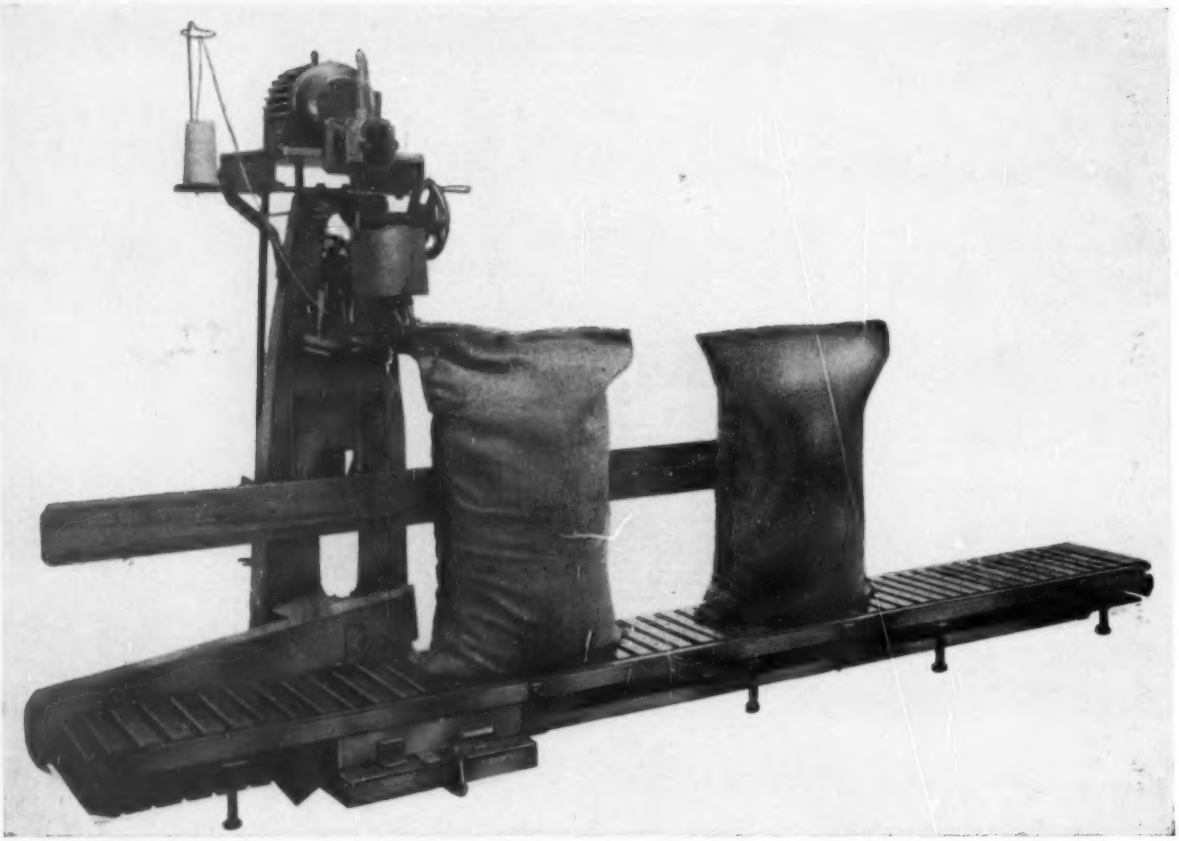
The 'Super' Universal Sack Closing Machine

MODEL NO. 5B

Fitted with 10 or 12 ft. Conveyor and Special Clutch Drive



This machine is fitted with a conveyor 10 or 12 ft. overall and a Special Clutch Drive which allows the conveyor to be run independently of the sewing head.

Jute, Hessian, Paper Lined Hessian, Cotton and Paper Sacks weighing from 50 to 325 lbs. can be sewn on this machine.

Machines can be seen working by appointment.

Power required 2 h.p. *Shipping weight : 14 cwts.*

Manufactured in Great Britain by :

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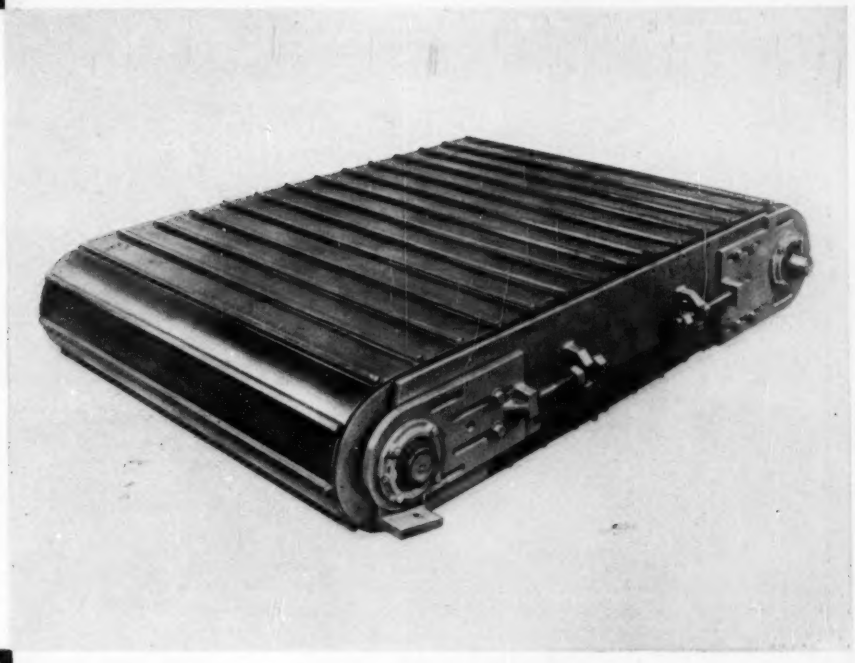
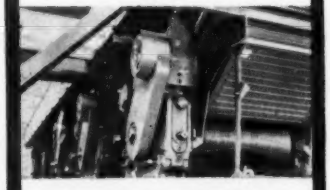
FARREL® RUBBER-BELT CARRIERS *(patented)*

AMAZINGLY DURABLE

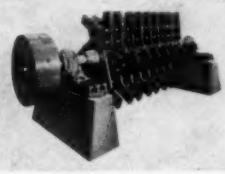
they are gaining world-wide popularity



OTHER EQUIPMENT
reflecting Farrel leadership in sugar mill design



WICHITA AIR CLUTCHES
used in the carrier drive, contribute to ease and safety of operation; also used between gear units of a turbine drive.



REVOLVING CANE KNIVES
provide high efficiency with economy in the preparation of any kind of hard or soft cane.

More and more modern sugar factories the world over are standardizing on Farrel rubber-belt intermediate carriers. This has been proven by recent orders from such widely separated places as the West Indies and South Africa.

Initial installations of these carriers have seen as many as six crops and handled approximately two and one-half million tons of cane with absolutely no down time. Not a penny has been spent for parts replacement.

Furthermore, this patented device has shown other important advantages. It provides better retention of bagasse and imbibition; it has greater force-feeding action than the slat type; and production can be significantly increased.

Write for 40-page bulletin 312 which gives details of this new development, as well as the other equipment shown.

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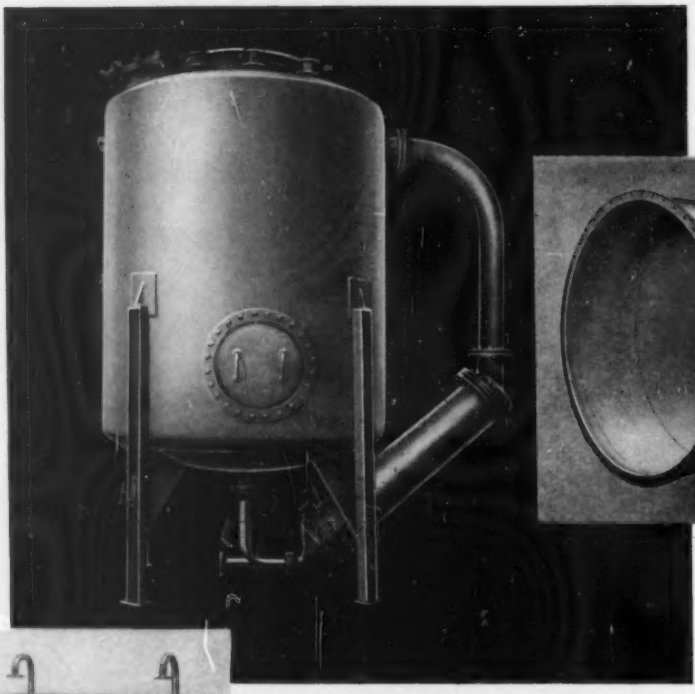
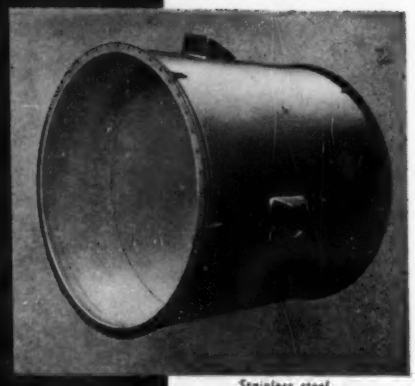
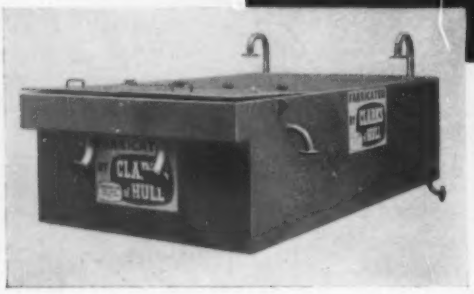


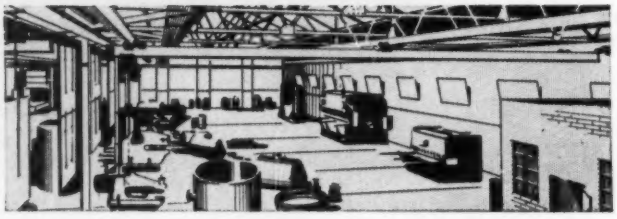
1,000 gall. kettle in ¼" copper. Lynx Quasi-arc welded.



Stainless steel vessel with mild steel jacket

12,000 gallon water separator





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Clark's modern methods, efficient equipment, unique facilities and practical approach all operate to your advantage....

Clarks offer you a unique combination of the most advanced equipment and methods with a century-old reputation for high craftsman standards on every type of fabrication work.

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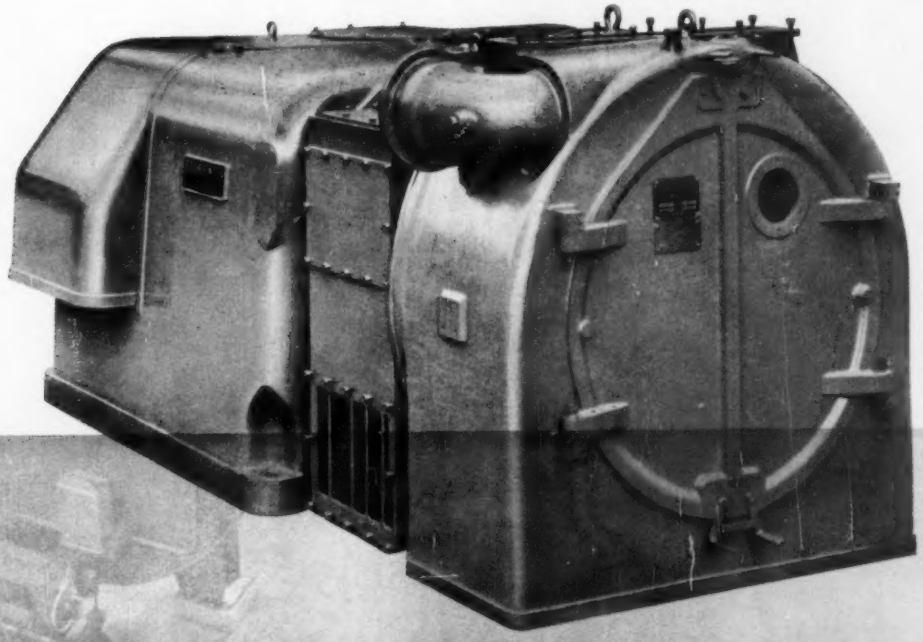
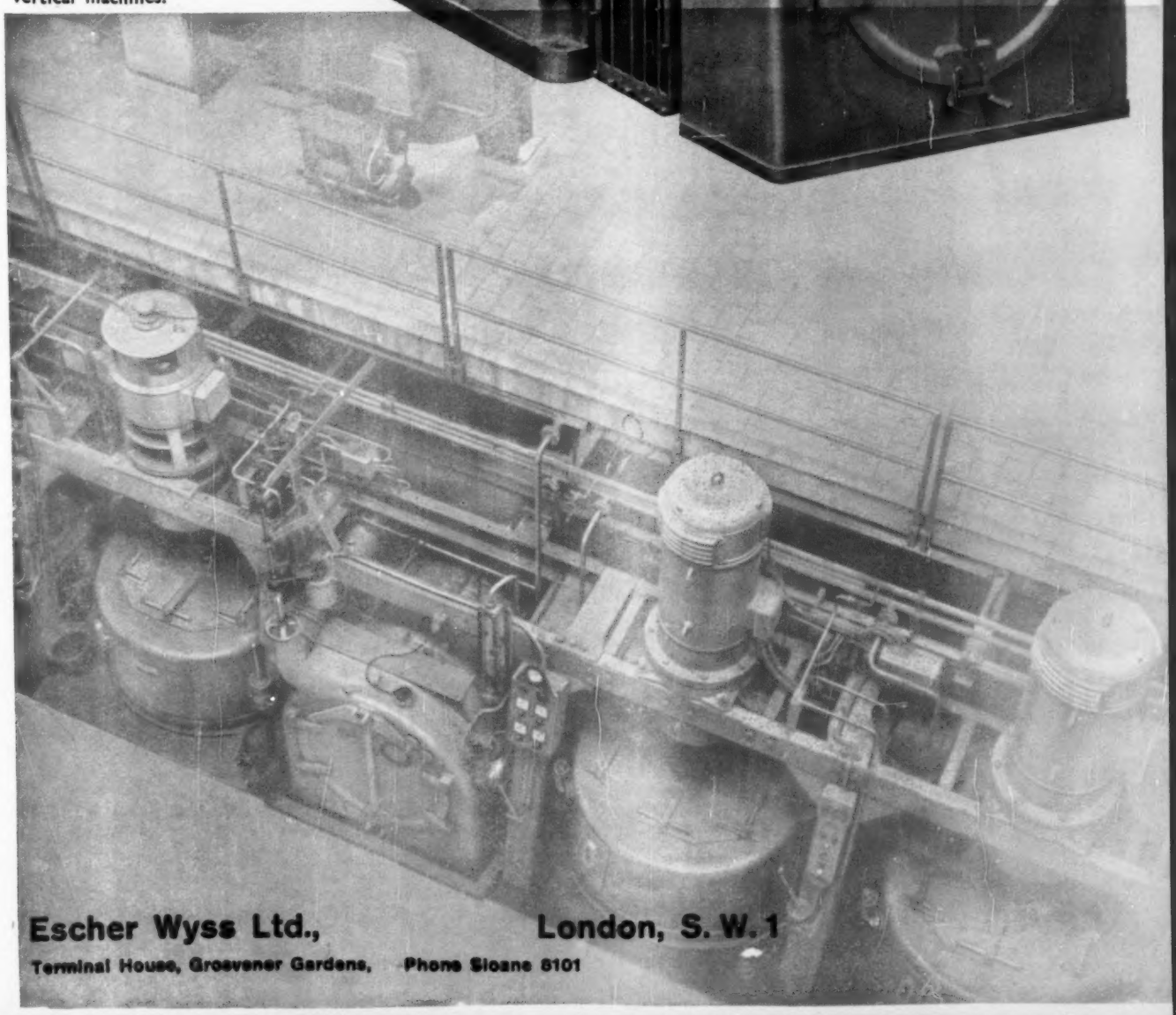
ESCHER WYSS

continuous centrifuges for the sugar industry

These centrifuges are in operation at Sugar Factories throughout the world.



Escher Wyss Centrifuge as replacement in a battery of vertical machines.



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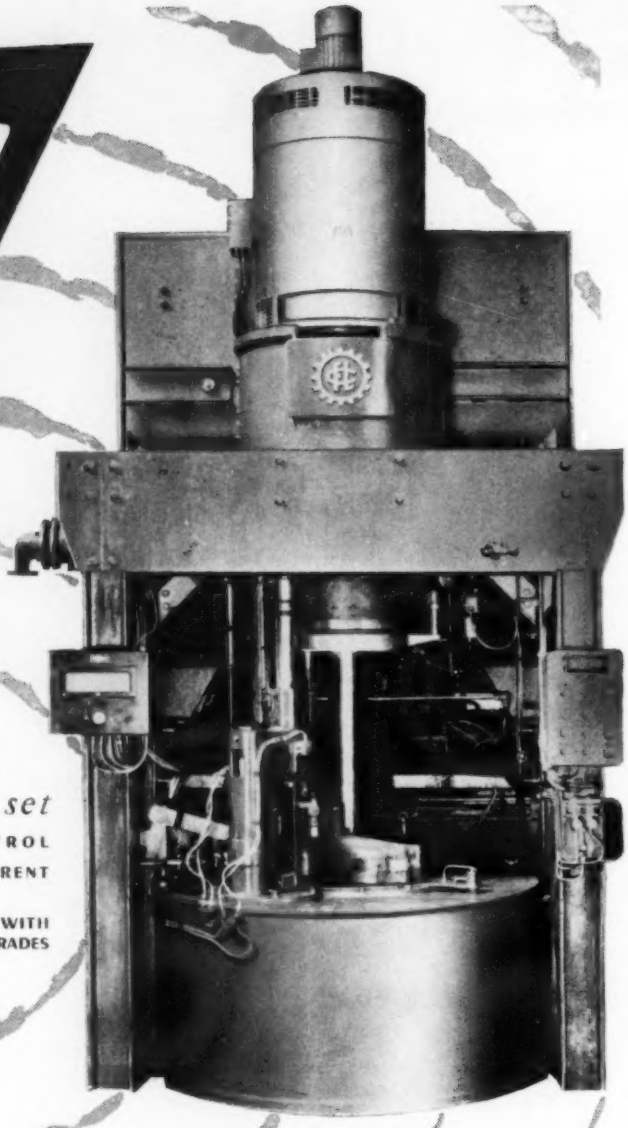
Terminal House, Grosvenor Gardens, Phone Sloane 8101

Fully automatic!

the new

CENTRIFUGAL



driven by
WARD-LEONARD *set*

- ELECTRONIC CONTROL
- ELIMINATION OF CURRENT PEAKS
- RECORD PRODUCTION WITH MASSECUITES OF ALL GRADES

Battery of 4 centrifugals at the Fontaine-le-Dun Sugar Factory (France)

S.A.G. - PARIS

FIVES LILLE - CAIL

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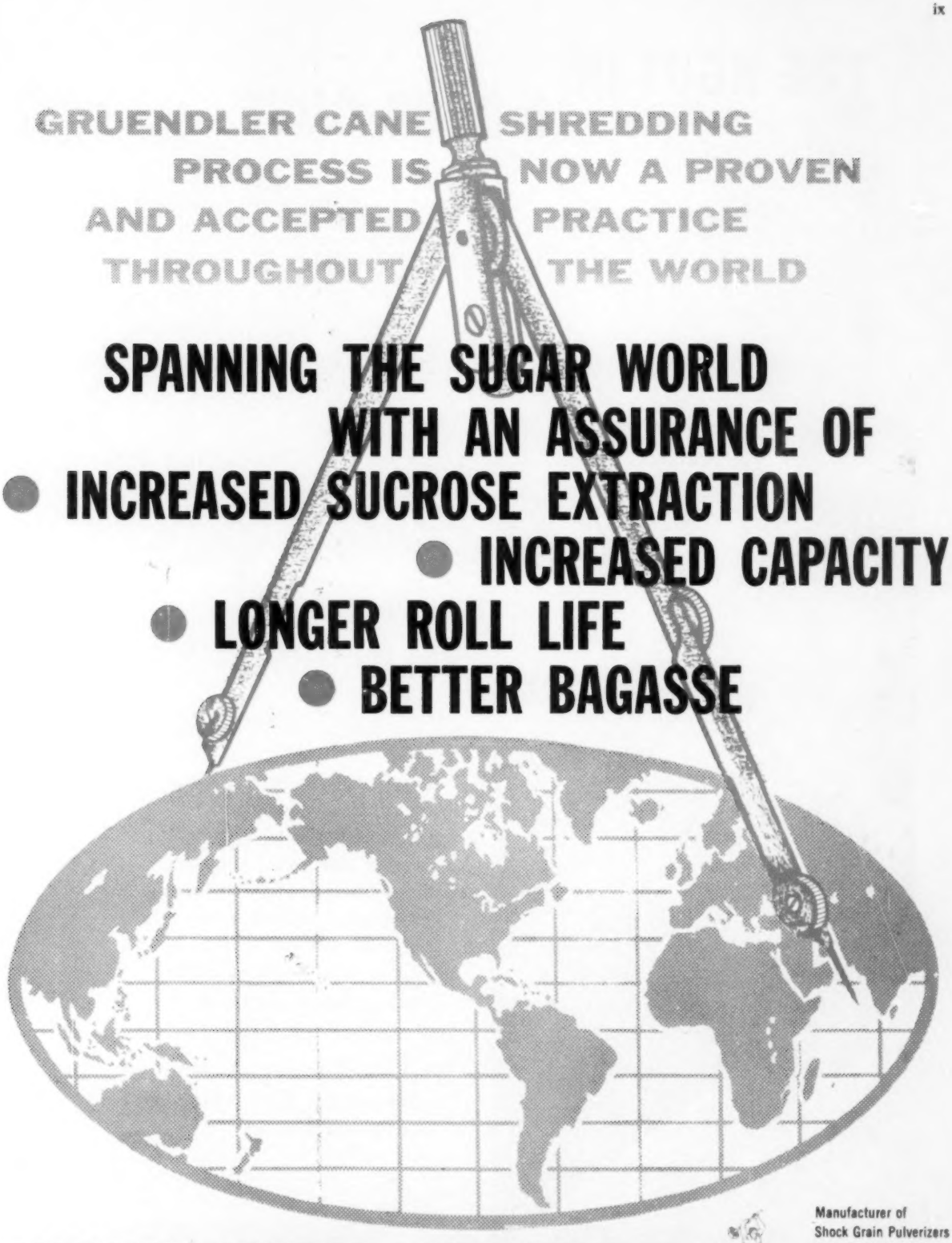
GRUENDLER CANE SHREDDING PROCESS IS NOW A PROVEN AND ACCEPTED PRACTICE THROUGHOUT THE WORLD

SPANNING THE SUGAR WORLD WITH AN ASSURANCE OF

- INCREASED SUCROSE EXTRACTION
- INCREASED CAPACITY
- LONGER ROLL LIFE
- BETTER BAGASSE



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Established 1885

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Cane Trash Shredders
Bagasse Cleaner
and Filter Aid
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Elevating and
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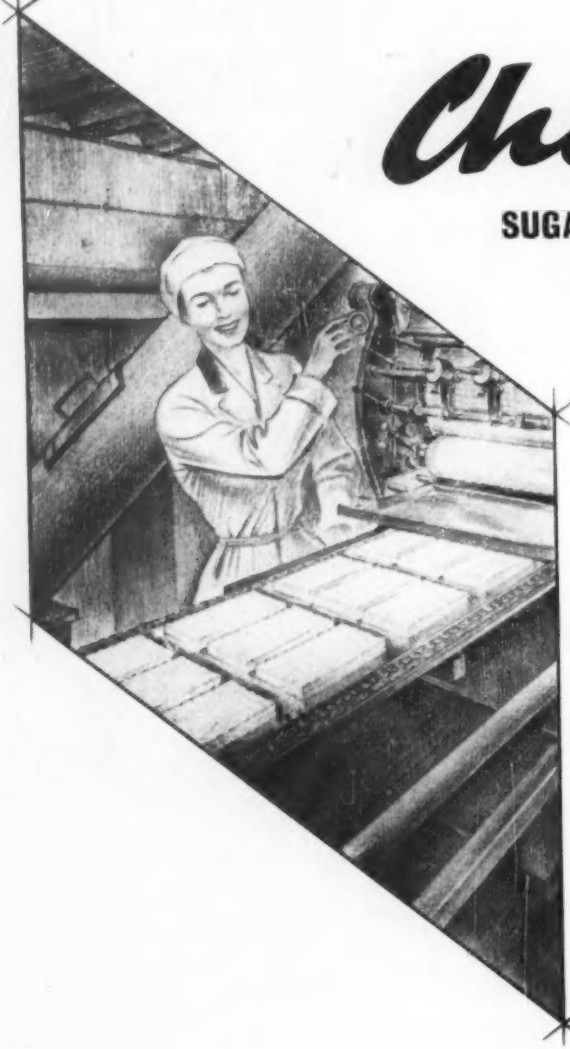

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SUGAR MOULDING AND PACKETING PLANT

Chambon Sugar Plant produces perfect cubes or dominoes. The moulding, drying, packeting and weighing is carried out in one continuous operation with simplicity and speed. Its requirements in labour and floor area are small in relation to its high productive capacity.

Illustration shows final stage of automatic process.

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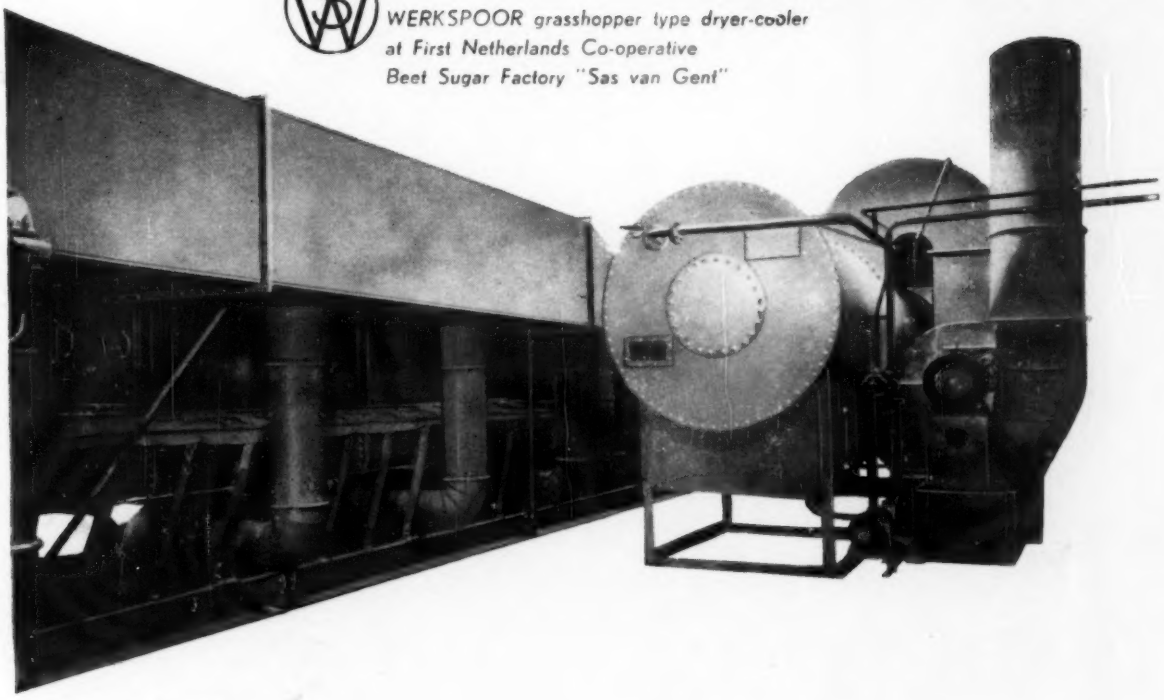
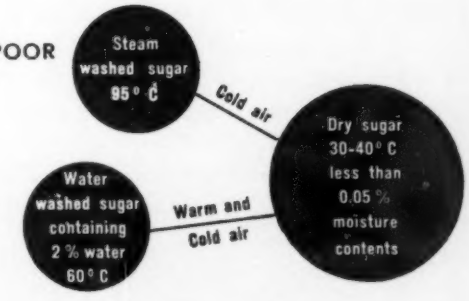
WERKSPOOR *grasshopper type dryer-cooler at First Netherlands Co-operative Beet Sugar Factory "Sas van Gent"*



This new* WERKSPOOR *grasshopper type dryer-cooler keeps the lustre of your sugar

with its simple and low construction, economical working, built in any capacity you may require, this modern WERKSPOOR apparatus will guarantee you:

- **absolutely undamaged crystals**
- **drying and cooling in record time**
- **close contact air-sugar**
- **completely dust free atmosphere**


Steam washed sugar 95° C
Cold air
Dry sugar 30-40° C less than 0.05 % moisture contents
Water washed sugar containing 2 % water 60° C
Warm and Cold air

STORK — VERENIGDE MACHINEFABRIEKEN V·M·F NEDERLAND STORK • WERKSPOOR — WERKSPOOR

For grasshopper type dryer-coolers please apply to Werkspoor, Amsterdam

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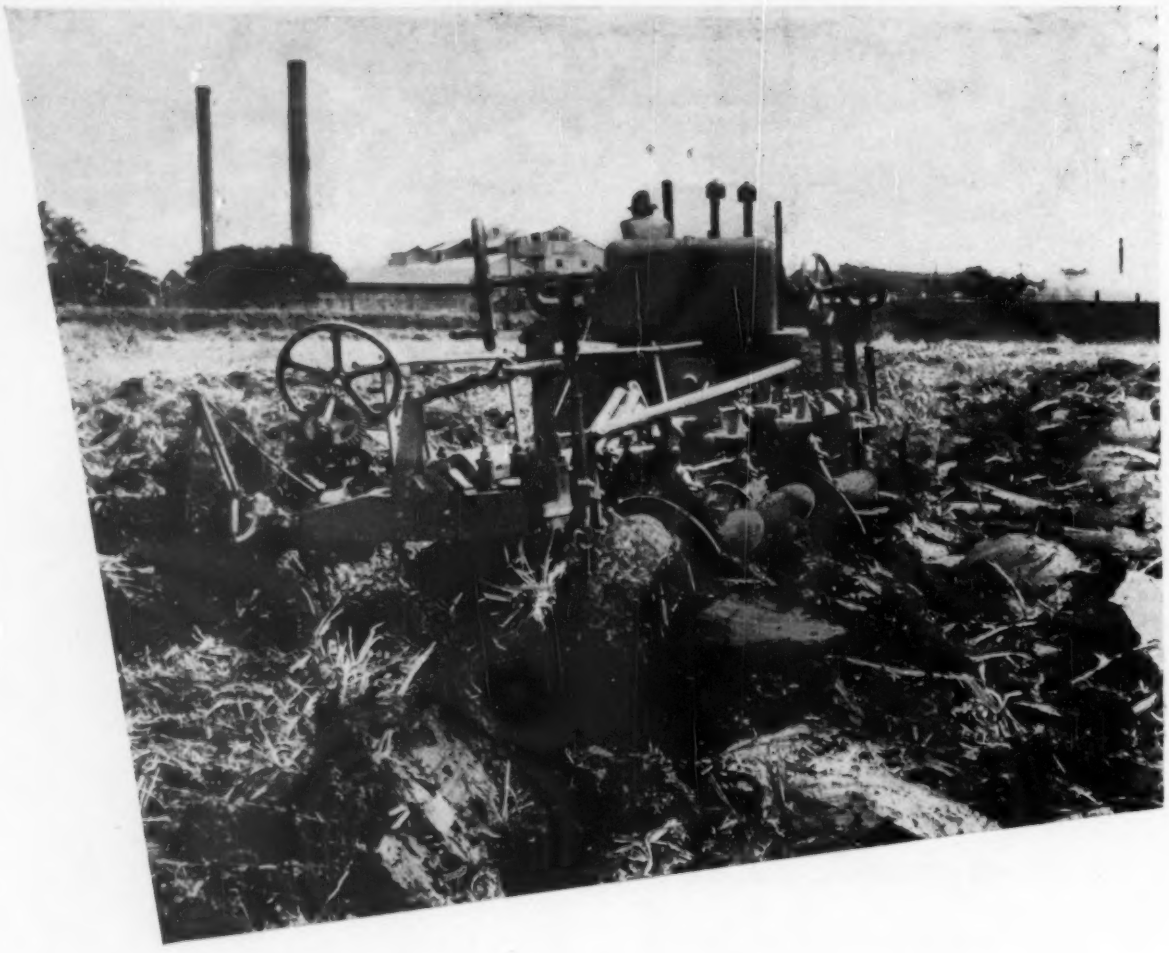

SUPREME IN ITS CLASS

Among heavy implements designed for the most strenuous work, the Shugadisc holds pride of place. Its immense strength enables it to take the hardest, roughest jobs in its stride and the clearance provided between the discs and under the beam enables it to plough in quantities of cane trash with ease, without choking or clogging. Made with 3 or 4 discs, the larger size weighing well over 3 tons.

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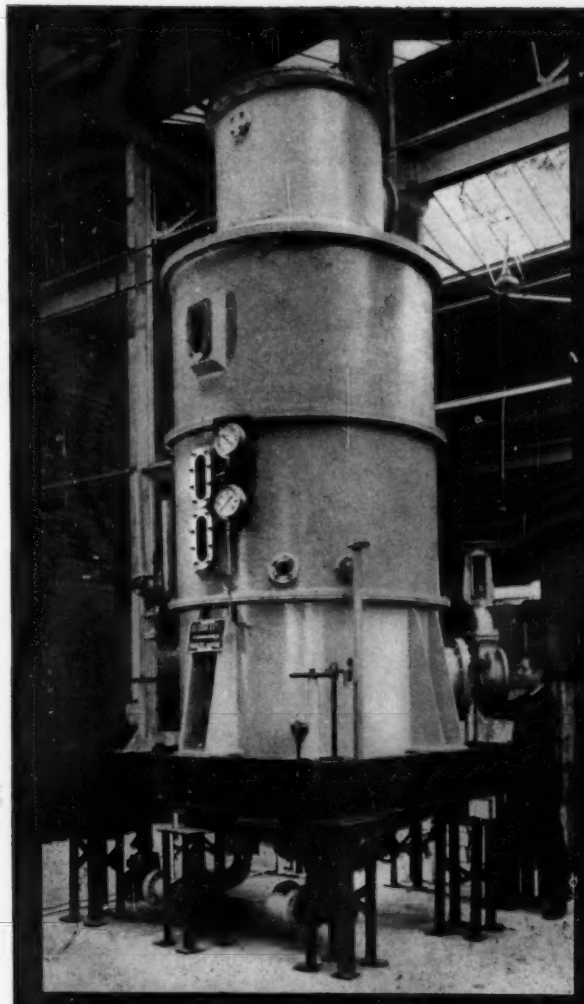

Evaporators by *CRAIG

* *manufactures of machinery for Complete Sugar Factories.*

The vacuum pans illustrated are part of the machinery supplied by CRAIG for this sugar factory in India.

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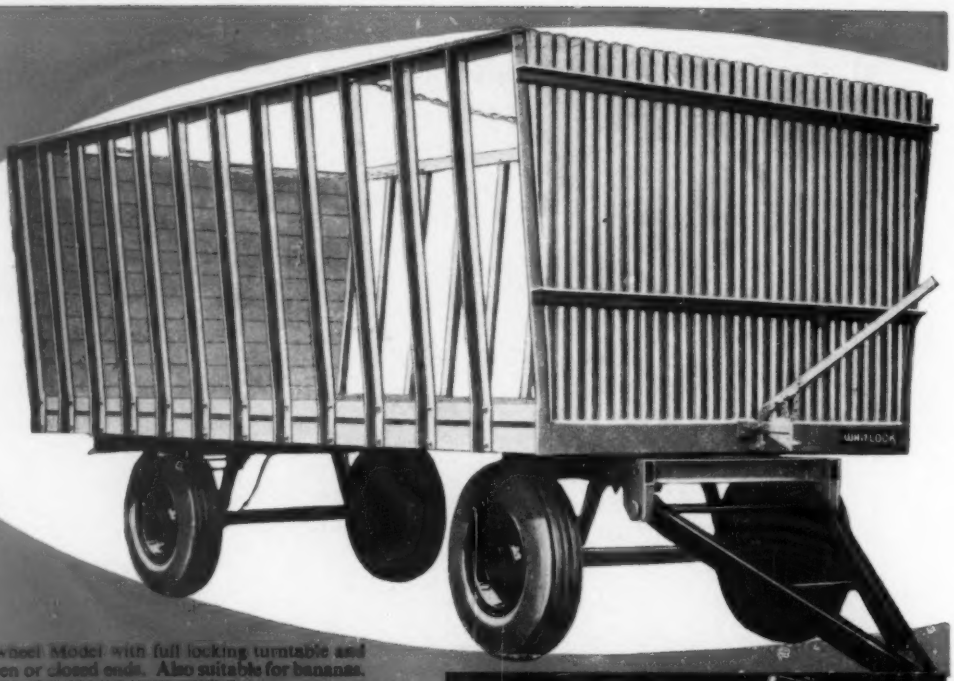
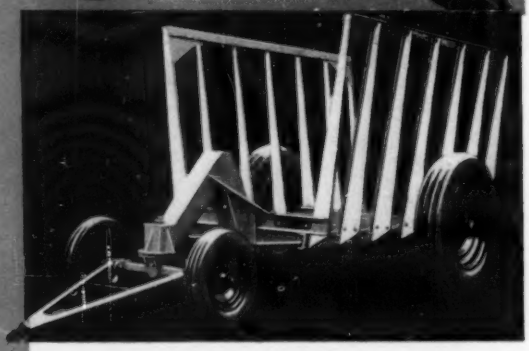


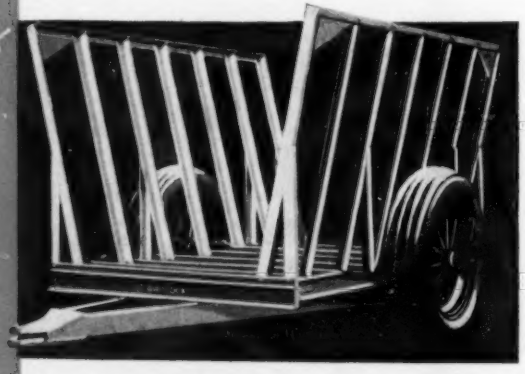
4-wheel Model with full locking turntable and open or closed ends. Also suitable for bananas. In various carrying capacities.

Cut cartage costs with

WHITLOCK CANE & FRUIT TRAILERS



4-wheel Goose-Neck type of pressed steel construction with extra heavy bracing for loads up to 6 tons.



A low cost model on large diameter wheels for loads up to 5 tons.

Our factory representatives are at the moment travelling the cane growing areas and may be visiting you personally.

Whitlock Cane Trailers are backed by many years experience and will stand-up to the job.

Ask for catalogue SC.41 and send details of your requirements.

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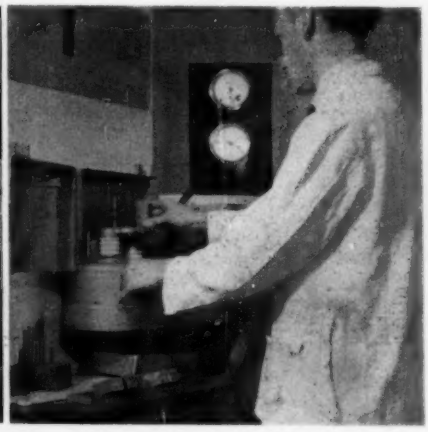
place at your disposal
their long, specialised experience
in the metallurgical development
and manufacture of

TUBES FOR THE SUGAR INDUSTRY

The resources of Yorkshire Imperial Metals Limited are devoted solely to the manufacture of non-ferrous tubes, plates and fittings, and plastic tubes and fittings. They have long been intimately associated with the Sugar Industry, both at home and overseas, and have made a careful study of the varied and often arduous operating conditions which obtain in the Industry. This study has resulted in the development of improved tube and plate alloys, metallurgically designed and scientifically manufactured to give the best possible service. This unrivalled experience is at your service, free of charge and without obligation, to assist in the solution of problems of all kinds affecting the life and use of non-ferrous tubes and plates.



Yorkshire Imperial craftsmanship, metallurgical skill and specialised experience, together with modern plant and methods and accurate control at every stage of manufacture, account for the enviable reputation which *Yorkshire Imperial* tubes and plates and *Yorkshire Imperial* fittings have achieved in their respective fields.

TUBES IN "YORCORON/KUNIFER 30A" · "YORCUNIC/KUNIFER 10" COPPER AND "SEVA" BRASS · PLATES IN A WIDE RANGE OF ALLOYS · BI-METAL TUBES AND PLATES.

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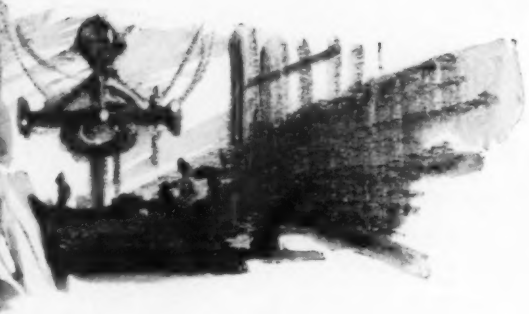
Helping to sweeten it is our cup of tea



Tea needs sugar. Sugar needs refining. Refineries need gears. Big gears, heavy gears, reliable gears. That's where the Jackson Division of David Brown comes in.

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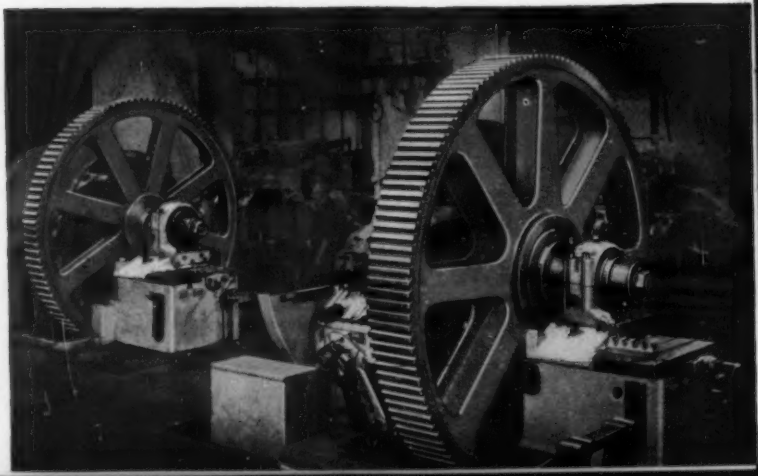

Use rugged LINK-BELT

900

class chain

for intermediate cane carrier service

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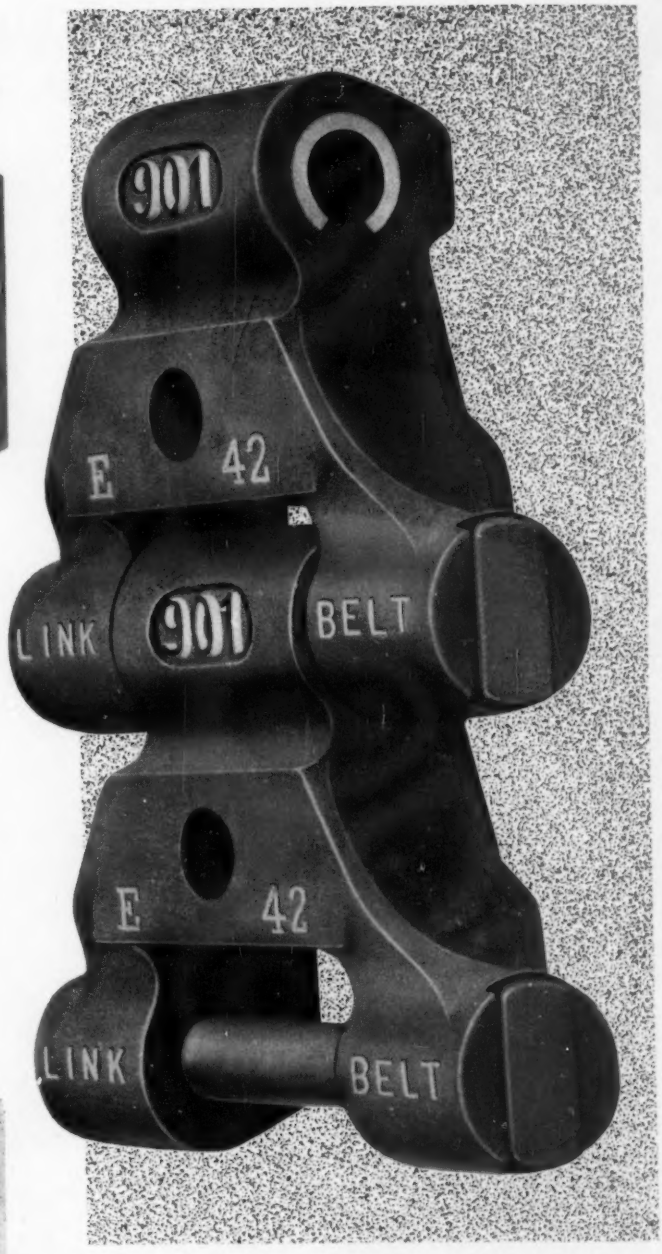

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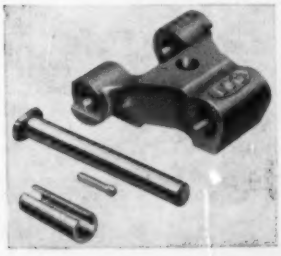

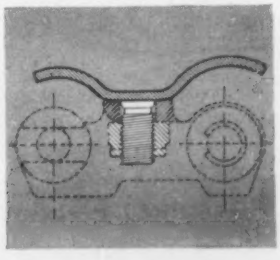

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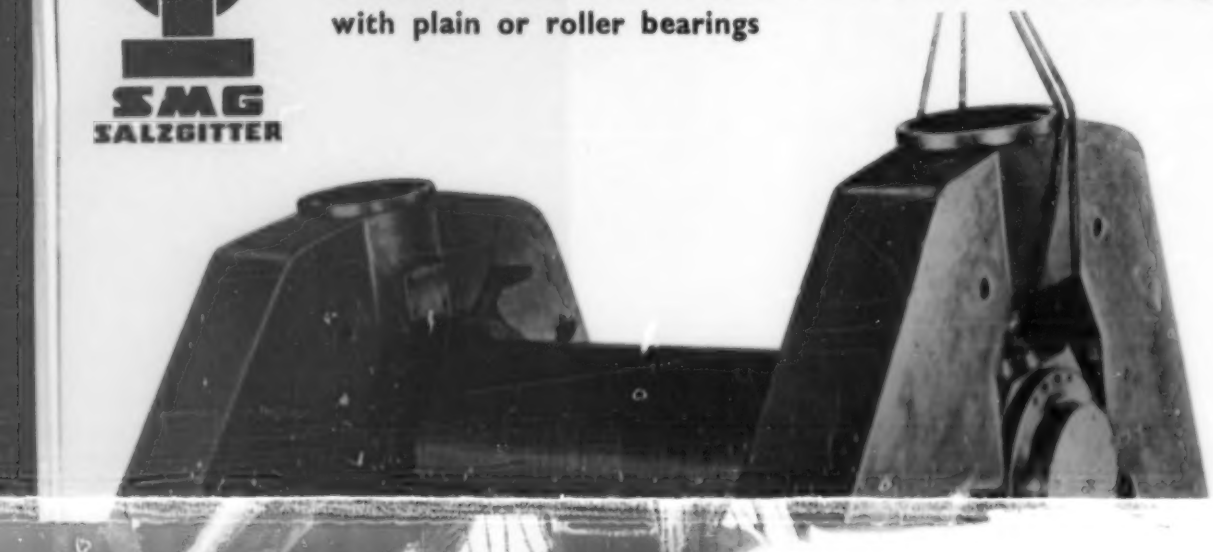

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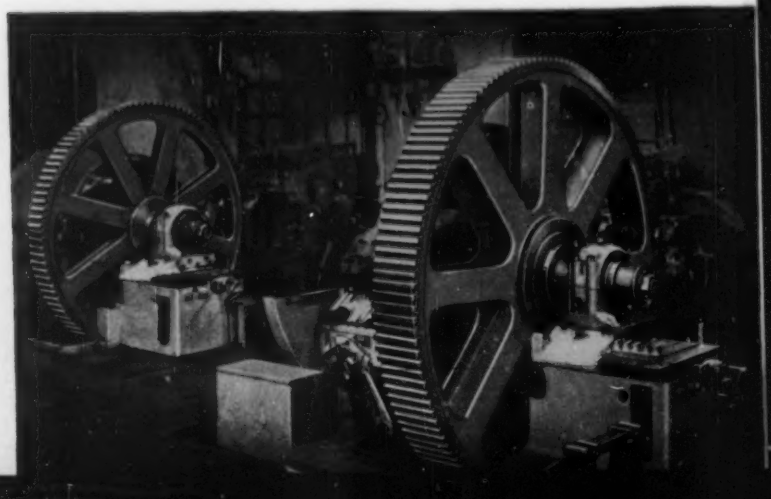

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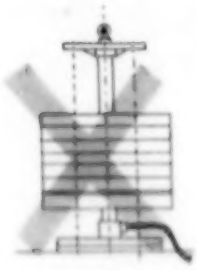

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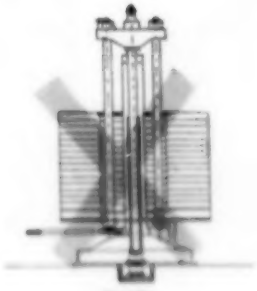

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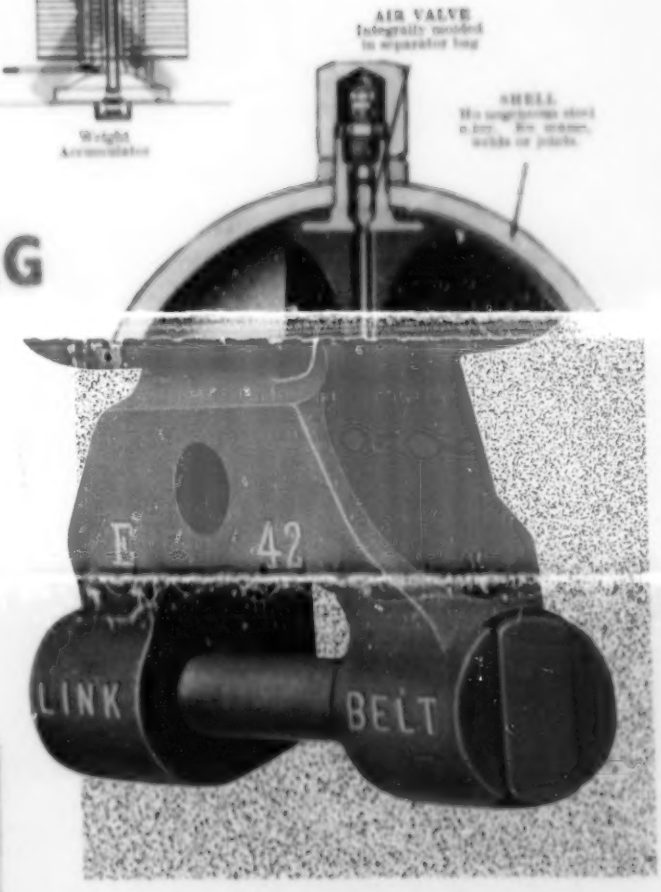

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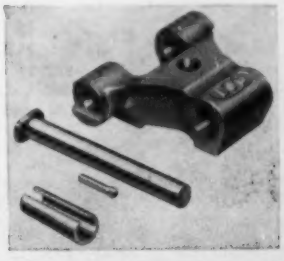

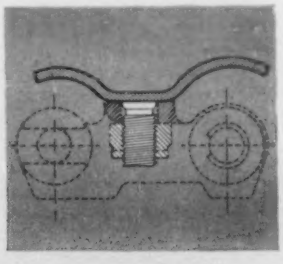

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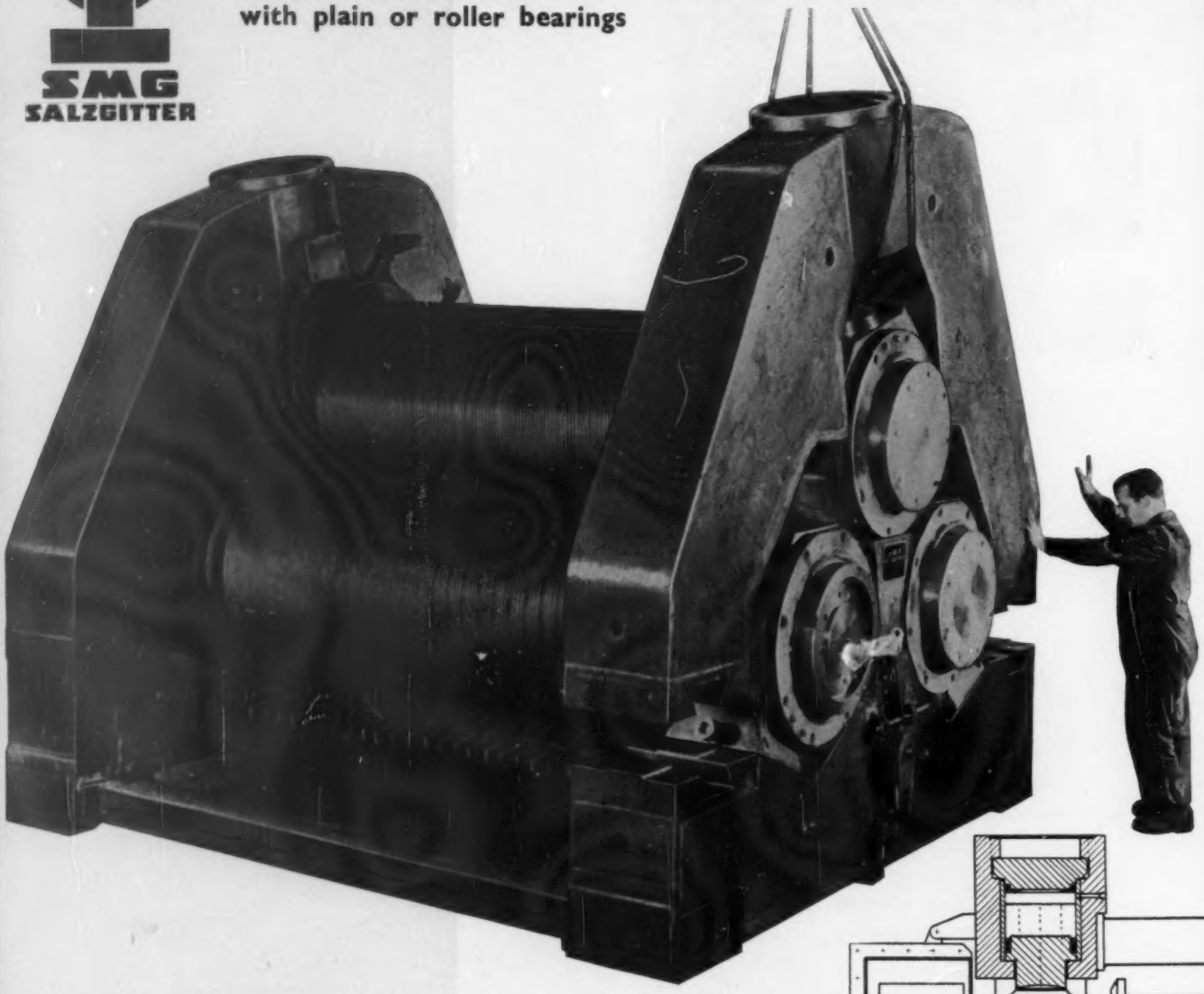

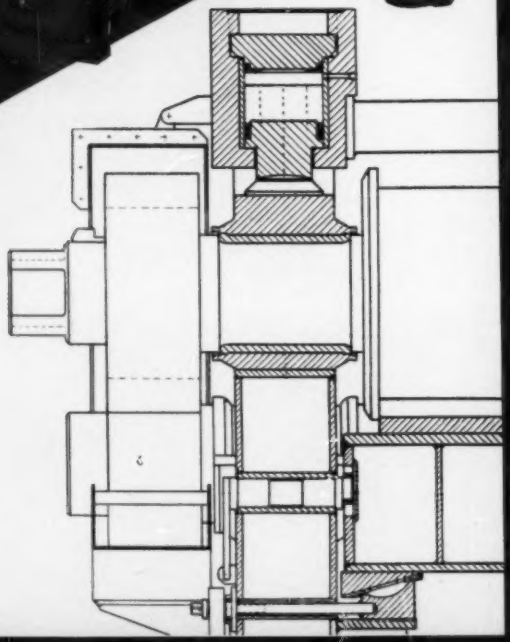

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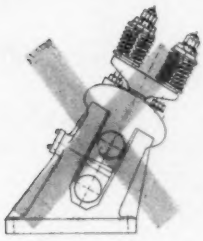

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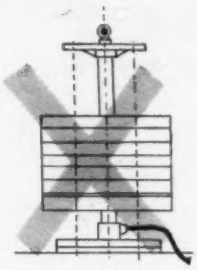

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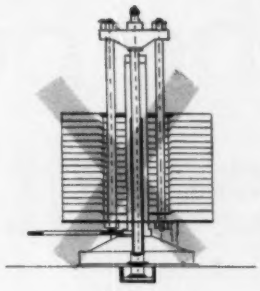
Accumulator



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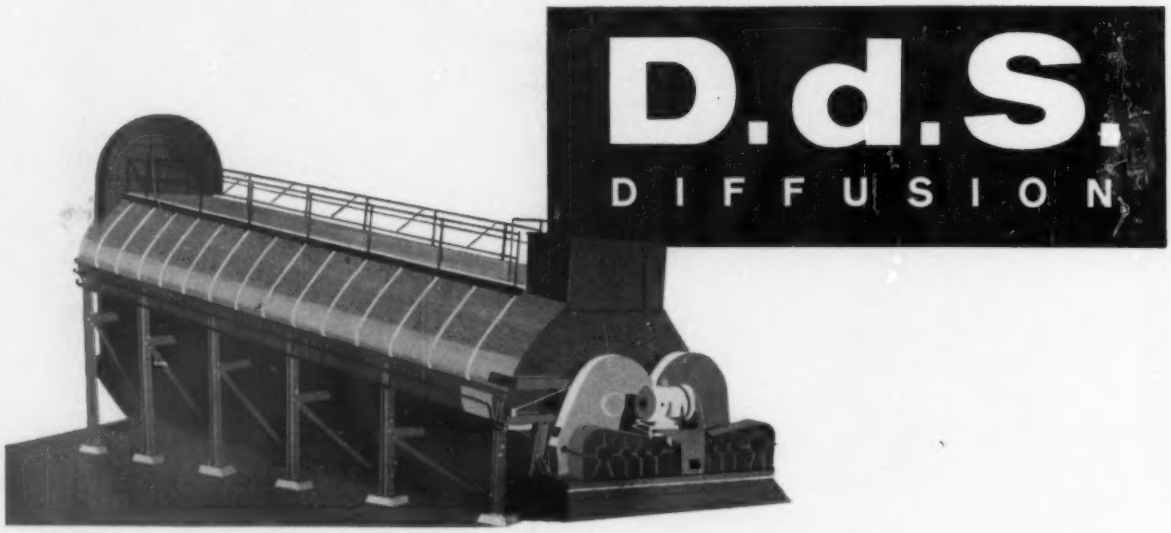

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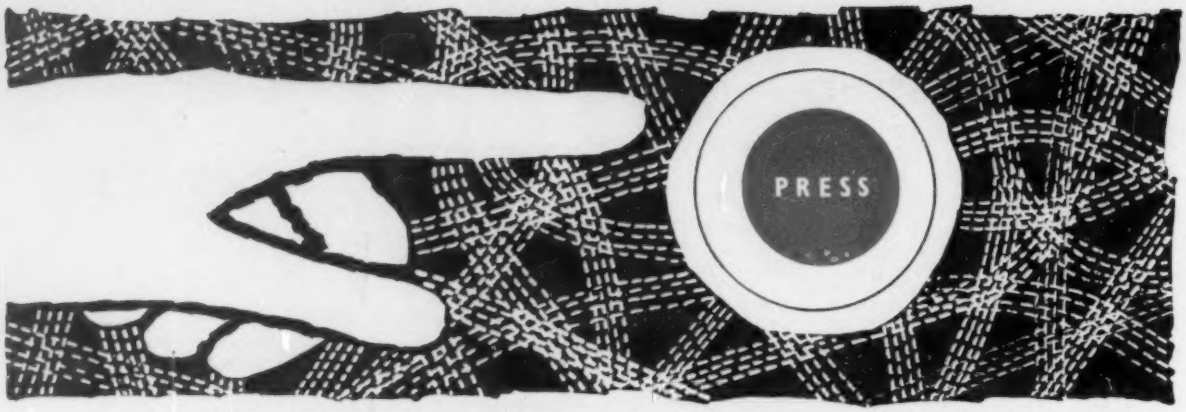

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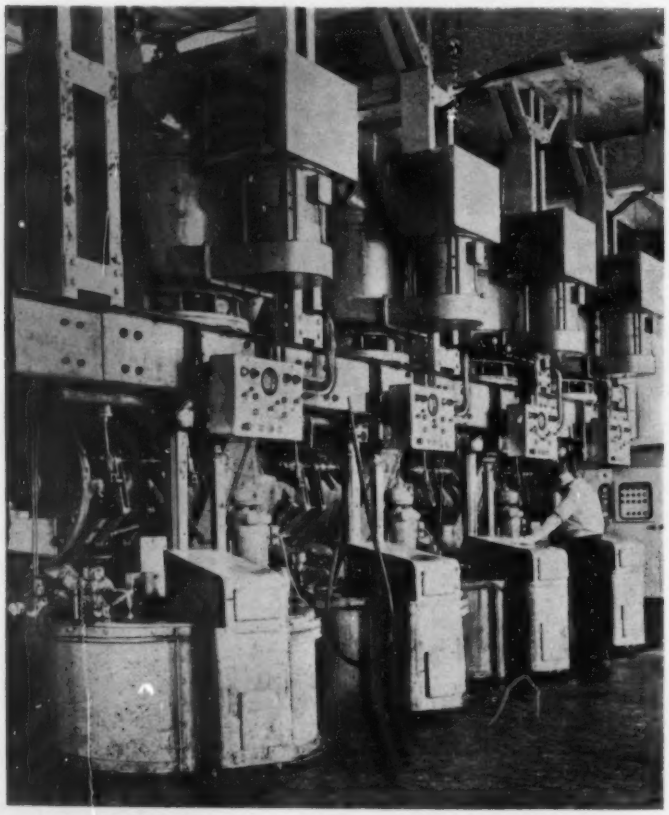

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VOL. LXII FEBRUARY, 1960 No. 734

NOTES AND COMMENTS

Tate & Lyle Ltd. 1958/59 report.

Sales of refined products in the year ending 3rd October 1959 totalled 2,113,665 tons against 2,077,237 tons, the home trade taking 1,534,395 tons (73%) and export sugar 579,270 tons (27%).

Export trade was very widely spread, sugar selling to some eighteen Commonwealth countries of which the most important were British West Africa, British East Africa and Malaya, and to thirty foreign countries of which Iraq, Tunis, Saudi Arabia, Norway and Switzerland were the largest buyers. Although the export tonnage was reduced, better margins were secured than in the previous period. Increased profits also accrued from substantial savings in costs on all the refined products, which has made it possible to reduce the margin on home trade sales, with the result that it is still further below the limit guaranteed to the Chancellor of the Exchequer than it was at the beginning of the year.

To ensure continuity of supply and economical buying, it was thought advisable to increase the Company's long interest in sugar (the sugar standing at market risk) to approximately 250,000 tons. To ensure the same continuity of supply of shipping it is necessary to have in hand additional cargo space equivalent to 300,000 tons of sugar.

At the annual general meeting, SIR IAN D. LYLE, chairman of the company, said:—

"The purchase of a controlling interest in the Canada & Dominion Sugar Company is the subject uppermost in our minds.

"Now that the scope for expansion in sugar refining in the United Kingdom is limited, Canada stands out as the ideal country in which to apply our resources and management know-how. It is within the Commonwealth; it has a stable Government, and an enormous potential increase in population, and therefore in consumption in sugar. We have been buying Canada & Dominion shares in the open market for the past seven years and at the time of our recent offer the Tate & Lyle Group held rather more than 12% of all the shares.

"During the past twelve months, Canada & Dominion have been going through a difficult period. The low world raw sugar price has seriously affected the earnings from beet sugar, both during this year and last.

"During last summer we found that more and more calls were being made on us both for advice and for personnel. The time was also approaching when a change in the top management would become inevitable. Mr. MCGREGOR, who has been President for 18 years, has had a life-time with the Company. Recently he has found his health can no longer stand up to the continuous strain of almost single-handed management. It was also apparent that the new top management would have to come from outside the organisation. With the holding of 12%, we naturally felt that if anyone was to be brought in to manage the Company, we would prefer to do it ourselves. On the other hand, 12% seemed too small a stake in the Company for such a large responsibility and diversion of effort.

"In deciding to make a public offer for 50% of the shares not already held by the Tate & Lyle Group, we were influenced by two considerations. First, Bank of England permission to buy the necessary dollars was conditional upon our acquiring legal control of the Company. The size of our offer, therefore, had to be large enough to achieve this. Second, we were advised that public opinion in Canada would look favourably on an offer which left a substantial minority interest in Canadian hands.

"At the reduced rate of dividend of 15 cents per quarter compared with 30 cents last year, the price paid of $25 per share yields only 2.4% and on this basis must appear generous. There does not appear to be an early prospect of better dividends; indeed, I envisage a very depressing picture at the end of the financial year in March. However, there are indications that next year will show an improvement and I feel sure that the more distant future holds prospects of great things".

Included with the Company Report is a brochure to commemorate the Henry Tate Centenary. It

records the entry of HENRY TATE into the sugar refining industry in 1859, within a few years severing his connexion with the grocery business which he had built up. The progress of the Liverpool and Thames refineries under him is briefly described and an account given of his philanthropic activities. A family tree extending to the 5th generation shows the descendants who have been and are in the Company. A series of photographs are presented showing scenes of Victorian times in sepia monotone and contrasting with colour photographs of the modern equivalents —sugar ships, refinery buildings, sugar store, filters, pans, cube-making plant, and refined sugar transport.

* * *

A survey of sugar prices.

The above is the title of a mimeographed booklet recently issued by the International Sugar Council and written by JOHN A. HOPKINS. It describes the results of a study to obtain current factual information on the wholesale and retail prices of sugar and the differences between geographic regions and producing and consuming regions as well as the facts concerning the levels of sugar taxation and its influence on price. It is based on information collected from representatives of countries and territories representing about 90% of world consumption outside Eastern Europe and Mainland China. A questionnaire sent in February 1959 requested data on prices of sugar produced or marketed in each country, import duties and taxes, while a second in March asked for details of retail prices of starchy or fatty foods which might compete with sugar in providing calories in food. A third questionnaire in late September asked for wholesale and retail sugar prices from January to October 1959. The information is recorded in tables and graph form. A significant item in the cost was the taxes levelled on sugar, ranging from 0·03 to 25·5 U.S. cents per kilo, or 0·3–69% of the retail price. They go a long way to explain the wide dispersion of retail prices as between countries and their modification of these prices materially affects the consumption of sugar. A comparison was made of the costs of sugar and other calorie-providing foods by calculating the cost in U.S. cents of 1000 calories derived from each. In most areas, sugar was found to be a relatively cheap food, although generalisations for regions can be made only up to a point and variations between countries within each region are usually wider than regional averages. In some regions there may be local foods which are cheaper, under favourable circumstances, yet 1000 calories in sugar cost less than in bread in 55 cases out of 78 while in 5 other cases the sugar would have been cheaper had it not been for taxes. Calories in sugar were cheaper than in potato in 75 out of 78 cases, and cheaper than in rice in 50 cases (but not in the Asian countries).

The outstanding fact from the survey of prices in 1959 was that in the face of an appreciable increase in sugar supply and a sharp decline in the price of raw sugar, 28 countries out of 53 reported no change in wholesale prices and 29 reported no change in retail prices. In 7 areas wholesale prices increased while in 18 areas they declined. Retail price increases occurred in 16 areas where the influence of other forces outweighed the price of raw sugar and the existence of increasing sugar stocks. The rigidity of prices over periods of years due to governmental intervention means that the volume of consumption remains constant except for population growth and upward trend in per caput consumption so that the lack of price response in countries which represent an an important sector of world consumption makes it more difficult to dispose of surplus sugar resulting from a year of large crops.

* * *

U.S. supply quotas 1960[1].

On 17th December 1959 the U.S. Dept. of Agriculture announced the initial estimate of U.S. domestic requirements at a total of 9,400,000 short tons, raw value. This is the highest ever initial quota but is equal to the current level of requirements for 1959. According to C. Czarnikow Ltd.[2], the department had taken note of the fact that in the year ended 31st October 1959, distribution amounted to 9.2 million tons whilst there was no evidence of any substantial difference between users' beginning and end stocks. On this basis it was estimated that normal population growth would take consumption to some 9,375,000 tons in 1960. Cuba has the largest quota at 3,119,655 short tons, followed by Domestic Beet with 2,043,480 tons, Puerto Rico with 1,192,498 tons, Hawaii with 1,140,462 tons and the Philippines with 980,000 tons.

* * *

Beet price and sugar targets in France.

An Inter-ministerial decree of 14th October fixed the "indicative" price of beet for the 1960/61 campaign at 6700 francs per ton, or about 1000 francs per ton less than the average for the Common Market countries. The *Bulletin* of the Centre d'Etudes et de Documentation pour l'Utilization du Sucre points out that the Government should persuade the beet planters to *increase* their sowings for the 1960/61 crop in spite of the disastrous 1959/60 campaign. The same decree set the sugar production target for 1960/61 at 2,050,000 metric tons which is to be the target for 1961/62 and 1962/63 also. The *Bulletin* protests that this is in spite of increasing consumption, the hope of maintaining exports to Morocco and Tunisia and the absolute necessity of maintaining a stock of 200–300,000 tons. It is pointed out that had such a stock not existed, massive imports of sugar would have been needed as a result of the very poor beet crop this campaign. The necessity of increasing production is emphasized and it is considered that by keeping production at the decreed level for three years France would be renouncing her important place in the European sugar economy.

[1] *Lamborn*, 1959, **37**, 238.
[2] *Sugar Review*, 1959, (437), 211.

THE SUGAR CANE IN QUEENSLAND

Proceedings of the 26th Conference, Queensland Society of Sugar Cane Technologists, 1959.

OF the 9 sessions of the Conference, 7 were devoted to questions concerned with manufacture. Agricultural subjects were, in consequence, touched on very lightly at a single sectional meeting, the remaining meeting being devoted to administrative matters.

An interesting, if brief, account of soil conservation in the Isis area was given by R. B. MOLLER. The problem, as presented in his paper, differs somewhat from the usual form, for, in addition to the exposure of the soil to heavy rain incidental to a crop grown continuously in rows, such as sugar cane, much of the cultivation is on land normally considered too steep—slopes up to 15%—for anything but grazing. The red soil, however, has an inherent stability which has minimized the losses so far incurred by erosion. The two methods used are: contour banking at intervals of 70 to 90 ft and using a guide-line. In both cases the gradient adopted is steeper than normal and may be up to 1:50. This is desirable, at least in the first trial period, to secure a confidence not given with too low a gradient when, through water accumulation in the drills, the bank may be breached.

Phragmites communis, commonly known as "reed grass", is adapted to wet, swampy lands, but has spread along drainage ditches to invade cane lands which the monocultural system makes particularly suited to its needs. It has now become a pest, particularly in the Moreton district. Early attempts at control, mainly mechanical, proved of little value, merely propagating the plant vegetatively through sectioning its rhizome. Chemical control was attempted in 1953 with partial success only but, in 1956, "Dalapon," 2,2 dichloropropionic acid, was given a trial at the rates of 15 and 30 lb in 360 gal water per acre. The success is recorded by C. L. TOOHEY. At these rates the kill appears to be complete provided certain conditions are fulfilled. They are: the reed must be in vigorous growth and at least 2½ ft high, and a good wetting agent must be incorporated in the solution to ensure thorough coverage. The obstacle to extended use is its cost, at £37/10/0 per 50-lb drum. Later trials, at present incomplete, indicate the probability that a rate below 15 lb will be ineffective.

Treatment of cane setts with mercurial dressings was adopted initially as a protective measure against pineapple disease, *Ceratocystis* (*Thielaviopsis*) *paradoxa*. It was found to have, in addition, a stimulating effect, particularly on germination. S. O. SKINNER describes how, using a preparation of ethoxy ethyl mercuric chloride, he finds the effect stimulating when the whole stalks are sprayed while still in the lorry. The method appears worth adopting except under conditions unfavourable to germination and where a heavy infection of pineapple disease is known to occur. In such cases it is the setts that must be treated.

In the long hot water treatment of cane as a disease preventive, the range between effectiveness and injury in the matter of germination is narrow. The various factors involved in the treatment as affecting germination are reviewed by A. G. BARRIE. Among those noted are a seasonal effect, with reduced injury as September approaches. It appears possible, too, to identify certain fields, cane from which is more resistant to the treatment, but the reason is not obvious. Noted also is the possibility of the auxin content of the stalk being one of the factors.

With the progress of mechanization and the introduction of harvesting machines which cut the stalks into sections, it becomes a matter of importance to determine whether cane so cut up undergoes losses on standing which make such treatment undesirable. Evidence on this matter is given by L. G. VALLANCE and H. E. YOUNG from an extensive series of tests at four localities and covering 9 varieties. Up to 2 days between cutting and milling, and this covers the more important commercial period, there appears, in general, to be but little difference between the loss from cut cane and from whole stalks. Two exceptions are noted, the first in the case of varieties attacked by red rot, the second on the occurrence of very humid conditions leading to heavy fungal growth. The excess loss of c.c.s. is estimated at about 1%, or less than 1/- per ton cane. Successful mechanized harvesting of cut stalks is estimated to save many times this figure.

A system of payment, whether for cane or beet, which would enable the farmer to be paid for quality and encourage him to secure that quality in his crop, is eminently desirable, but the practical difficulties in finding one which will be acceptable to the farmer are considerable. In the paper G. A. ANDERSON, B. J. RUTHFORD and K. A. STUART describe the nature of the changes which have taken place in recent years as the result of harvest mechanization, the almost universal pre-burning and, in some cases, the increased extraneous matter delivered at the factory. They then describe in some detail the methods of sampling and analysing individual cane deliveries under what is termed a "juice weigher system". Cane payments can be based on this system.

H. M.-L.

Varietal competition in bunch planting in sugar cane breeding. C. S. YANG *et al. Taiwan Sugar*, 1959, 6, (4), 13–21.—The work was designed to study the degree of varietal competition in bunch planting, five setts, each representing a different variety, forming a bunch in place of seedlings. The decisive factor appears to have been the varietal competitive ability in tillering at an early stage.

MECHANICAL CULTIVATION IN INDIA

THERE has recently come to hand a book[1] which, though published three years ago, is of considerable interest, for it faces squarely the problem of how a system of mechanization may be introduced into an area in which small—from 5 acre or less to 10 acre—holdings dominate. It is a problem with which the sugar industries of some countries other than India are intimately concerned. The problem has both an economic and a social aspect, and its discussion, though far from offering any firm solution, is worthy of close study. Much of the book is devoted to a description of power units and implements together with their maintenance; important though these aspects be, they will not be considered here. It suffices to say that, while there is a not inconsiderable field of utilities for mechanization in opening up such areas as the Tarai, that broad belt along the foot of the Himalayas until recently closed to permament settlement because of malaria, on the larger estates such as those of the Central Indian plateau on which cane is grown, and in levelling and preparing land to be brought under irrigation, these areas are relatively small when compared with the total cultivated area.

The smallest conceivable mechanized unit lies far beyond the means of the peasant, both in capital and in economic use. Some central credit-worthy organization, capable of supplying the heavy capital, of providing efficient maintenance and of undertaking contract work, appears to be an essential element in any practicable scheme.

Approximately half the book is devoted to these organizational aspects and the complexity of the organization visualized is best indicated by the fact that it has taken an Appendix of 65 pages merely to set forth the numerous returns to be kept by a single Divisional organization. It is true that the finance involved is large, that, with the individual working units widely scattered, openings for abuse are considerable and that a strict system of control is necessary; but it is possible to argue—and there is ample evidence to support the view—that any adequate system of control must be so costly in overheads as to make the organization self-stultifying. It is an argument particularly pertinent when it is realised, as is realised by the author in his comments "The State will, therefore, have to shoulder most of the responsibility" and "Since the State will have to provide the necessary initiative" that, under present conditions, the State is the only possible agent. It is true that a stage is visualised at which much of the work could be handed over to contractors or co-operatives, and the Swedish example is quoted as a pattern; but the time is far distant when the Indian peasant, still largely under the thumb of the money-lender and still largely illiterate, will have developed a self-reliance approaching the standard of Sweden. The State is, and must for long remain, the sole practical agent and, unfortunately, it has to be admitted that State management and commercial solvency have generally proved incompatable—therein lies the dilemma.

The outlook for the development of mechanization in India, beyond the relatively limited scope of opening up new lands—whether dry in connexion with irrigation schemes—and on the larger estates, principally under cane—must be considered far from promising; and the grounds for this view are not limited to the financial aspects. In a powerful State organization, where personal responsibility is necessarily at a minimum, the staff is almost inevitably—for a very human characteristic is involved—carried away by enthusiasm and embarks on unsound courses. Such a case of misplaced enthusiasm comes to mind from the early days of the century when the U.P. Agricultural Department made strenuous efforts to replace the indigenous, non-inverting plough, which penetrated only some 4 inches, by a light turn-wrest plough penetrating to a depth of 8 inches. That the first effect of burying the top soil under a layer of sub-soil would be to destroy the fertility was overlooked. It is true that the ultimate fertility was improved but the peasant was not in a financial position to lose a single crop, and the "*izzat*" ("credit" or "reputation") of the Department fell considerably. Such a misjudgment might well occur again. It is a main and valuable feature of the book that it throws into relief this dilemma of an official organization incapable of making a successful attack on the problem through an inevitable overload of what is commonly termed "red tape" and of a peasantry not yet adequately equipped with a self-reliance on which a co-operative organization could be built. The possibility of a third, and more promising organization system need not be discussed at length here for it has already formed the main subject of an earlier article[2].

The introduction of a co-partnership system advocated there, into tracts already densely settled, is faced with its own peculiar difficulties, but even in closely settled India there are large tracts being opened up in which the system might be tried with holdings so designed in area and layout as to encourage mechanization. Throughout the Middle East, too, with population density lower than in India, both cane and beet are becoming grown on ever-increasing areas. In these countries, though the same urge to break up large estates and establish a peasant system is the order of the day, there is much land being newly brought under cultivation to which the same principles could be applied.

Even in those countries where the plantation system is firmly extablished the suitability of the system may well be tried out as is already the case in British Guiana. The merit of D. A. GADKARY's book is that, though it does not mention this third system, it does not shirk the issue.

H. M.-L.

[1] D. A. GADKARY: *Mechanical Cultivation in India.* (Manager of Publications, Civil Lines, New Dehli.) 1957. 143 pp.

[2] *I.S.J.*, 1959, **61**, 355.

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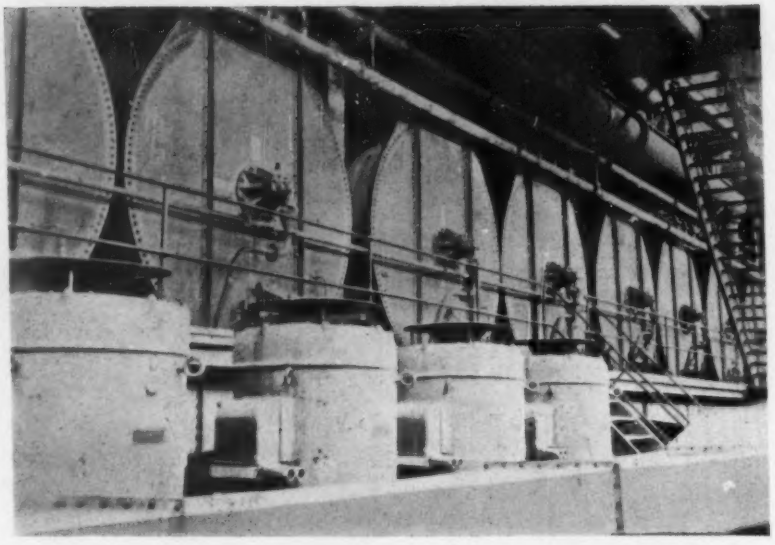

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SUGAR CANE AGRICULTURE IN MAURITIUS

MAURITIUS SUGAR INDUSTRY RESEARCH INSTITUTE ANNUAL REPORT, 1958.

WEATHER conditions were not as favourable as in the previous year[1] with damage caused by two mild cyclones and subsequent excess of rain, leading to reduced yields of cane and poorer juice respectively, the actual figures being (1957 in brackets): 24·9 tons cane per arpent (25·6), commercial sugar % cane 12·14 (12·93). Total production was 525,600 metric tons (561,600).

Cane Varieties

For the first time in 12 years, the weight of M 134/32 cane crushed fell below 50% of the total crop, and the extent to which this variety is passing from favour is indicated by the fact that the planted area fell from 50% of the total in 1954 to an insignificant figure in 1958 while the planted area of Ebène remained relatively constant at some 30%. A big increase is shown in the planted area of B 37172, from some 6% (1957) to 20%. It stood up well to the cyclones and, in general, is excellent for regions with a rainfall under 80 inches per annum.

Cane Breeding

The studies included observations on arrowing as affected by various forms of defoliation, applications of gibberellic acid, 2,4–D, trace elements, glucose and long hot water treatment. All were unsuccessful perhaps because the year was one of very low arrowing.

Owing to low temperatures during the crossing season, the year was also one of the worst with an average of some 45 seedlings per cross against a normal of 225. Attempts at replacing emasculation by hot water treatment for killing the anther have so far proved abortive, since no seedlings were secured on crossing; the effect on female fertility remained undetermined. A considerable amount of work, too, has been expended on statistical determinations designed to assist in seedling selection. The main characters of promising seedlings are noted, the primary objective of the work being to secure varieties adapted to the super-humid areas.

Cytological determinations of 5 commercial varieties are given together with notes on the preparatory technique.

Nutrition, Soils and Cultivation

A review is given of the range of the fertilizer programme with, perhaps, major emphasis on nitrogen and, in particular, its most economic form. Behind all this work lies, as a measure of fertilizer value, foliar diagnosis. Mauritius has played a leading part in the application of this measure in the sugar industry, and it has proved of immense value.

A section is devoted to questions of cultivation, irrigation and climate. A record is given of responses to the application of farmyard manure, scums, molasses and bagasse. The broad conclusion is that the organic residues left in the field at harvest provide the essential humus requirements and that N, P, K contents of the first three are a measure of their value. Bagasse differs somewhat from the other forms owing to its inertness; its application can result in a physical improvement of the soil.

Further studies with the application of ground basalt to the highly leached soils of the super-humid region indicate that the marked increase in yield, due not to better growth of individual canes but to increased tillering, is a response to an improved physical condition of the soil.

Cane Diseases

Two diseases that may be termed endemic, chlorotic streak and ratoon stunting disease, are discussed in some detail, including the hot water treatment which is common to both. The serious nature of the threat from the presence of Fiji disease in Madagascar has led to joint action covering efforts to eradicate the disease and varietal trials for the determination of relative susceptibility. Further anxiety has arisen from an outbreak of gumming disease, *Xanthomonas vasculorum*, in Réunion for which the possibility of a different strain cannot be overlooked.

Pests and Weed Control

An initial importation from India of the two parasites, *Elasmus zehntneri* and *Rhaconotus scirpophagae* of the stalk borer, *Proceras sacchariphagus*, is reported and brief notes are given of varietal susceptibility. Among comments on pests of minor importance and on the control of pests in general by insecticides, occurs a reference to nematodes. A remarkable increase in early growth after fumigation of the soil with ethylene dibromide is noted but it is too early to say whether this is the consequence of nematode control or of the general stimulation known to follow partial sterilization. The rather extensive trials with a number of chemicals, of which the results are recorded in tabulated form, cannot be summarized here.

The Report concludes with brief sections on sugar yields in relation to climatic factors, dominantly rainfall, and on varietal resistance to cyclones and on the effect of 2,4–D on sucrose content.

H.M.-L.

[1] *I.S.J.*, 1959, **61**, 197.

New harvester combine tested in Louisiana. L. PERKINS. *Sugar J.* (La.), 1959, **22,** (12), 12.—The good and weak points of the new Cary Combine[1] are briefly noted. The combine cuts the cane into lengths of 14 in or 21 in.

* * *

The cultivation of cane on steep hillsides. ANON. *S. African Sugar J.*, 1959, **43,** 407.—No inconsiderable area planted to cane in S. Africa is sited on steep hillsides. A brief note is given here of a visit of the South Coast Regional Mechanization Committee to one such farm, that of W. LINDSAY at Dududu. The deep fertile soil is first cleared of bush, worked by a 5-tine Ransomes C17K heavy-duty cultivator on contour to a depth of 18 in followed by heavy discs, drilled to 15 in and fertilized. "Aretan"-treated setts are placed, just overlapping, in the furrow and covered with 1 in soil with a final spraying of 2-4D. When the cane reaches 3 ft, the furrow is filled-in. The depth is stated to make maximum use of moisture and to assure better ratoons. All operations, including clearance, are performed with a Caterpillar D4 tractor.

* * *

Distribution of new variety N50/211. ANON. *S. African Sugar J.*, 1959, **43,** 597.—The chief characteristics of this cross between POJ 2725 x Co 285 are given. Its main advantages are its disease resistance and the freedom with which its trash is shed.

* * *

South Coast field day a great success. ANON. *S. African Sugar J.*, 1959, **43,** 707–712.—Though mainly of local interest, the article is freely illustrated, giving a good idea of the range of machines being introduced under the auspices of the South Coast Regional Mechanization and Labour Saving Committee.

* * *

A review of four years' work on foliar diagnosis at Victorias. F. T. TABAYOYONG, M. V. LACSON and M. ROBENIOL. *Victorias Milling Co., Expt. Sta. Release* (Philippines), 1959, (25), 28 pp.—This extensive collection of crop log data covers the period 1954–57 and the varieties POJ 3016, H 37-1933 and CP 29/116. The characters of which monthly data are given include sheath weight and moisture, leaf N, sheath P, K, Ca and Mg. The deductions under the several heads are too numerous to be given here.

* * *

Borer control by *Trichogramma*. ANON. *Victorias Milling Co., Expt. Sta. Bull.* (Philippines), 1959, **6,** (4), 2.—The release of *Trichogramma*, particularly *T. australicum* and *T. japonicum*, has been conducted over a series of years[2]. A brief Editorial note describes the success achieved.

* * *

Woolly Aphis control. ANON. *Victorias Milling Co., Expt. Sta. Bull.* (Philippines), 1959, **6,** (5), 2.—Success is reported in the control of the Woolly Aphis, *Oregma lanigera*, by spraying "Pestox", a systemic insecticide which is, fortunately, non-toxic to *Trichogramma*.

* * *

A review of variety × fertilizer tests, 1957-58. F. T. TABAYOYONG and F. A. BASILA. *Victorias Milling Co. Expt. Sta. Release* (Philippines), 1959, (26), 17 pp.—In this intricate series of trials only B 41-227 had a yield of sugar equal, within the range of significance, to those of the two standard canes, POJ 3016 and CP ×9/116 which occupy over half the cane area. POJ 3016, with N:Co 310, yielded the best juices. A single significant interaction between variety yield of cane (but not of sugar) and fertilizer was obtained.

* * *

***Trichogramma* breeding.** P. H. PORQUEZ and F. T. TABAYOYONG. *Victorias Milling Co., Expt. Sta. Release* (Philippines), 1959, (27), 11 pp.—The technique adopted is described in considerable detail. The host insect, of which the egg is used in the cultures, is *Corcyra cephalonica*, the rice grain moth. The breeding of *Trichogramma* has now been reduced to a routine process and, in 1958, a total of 525·4 million were released. The disturbing feature now being brought under control is the appearance in the cultures of the *Corcyra* larval wasp parasite, *Aplanetes sp.*, introduced with the corn meal used to feed the larvae.

* * *

Cane and sugar yield responses of POJ 3016, H 37/1933 and CP 129/16 to phosphorus and potassium. F. A. BASILA. *Victorias Milling Co., Expt. Sta. Release* (Philippines), 1959, (28), 9pp.—A statistical analysis is given of the 1957 plant cane 4 × 4 experiments, repeated at 26 locations. POJ 3016 gave significant responses both to P and K, H 37/1933 to K only and CP 29/116 to neither. There appears to be a positive, if not significant, interaction between P and K.

* * *

The effect of "Gibrel" on the growth and yield of sugar cane. E. P. VILLAREAL and O. SANTOS. *Sugar News* (Philippines), 1959, **35,** 165–167.—"Gibrel," a potassium salt of gibberellic acid, at strengths ranging from 20 to 100 p.p.m., and applied in two doses at 90 and 125 days after planting, produced increased growth

[1] *See also I.S.J.* 1959, **61,** 318.
[2] *I.S.J.*, 1958, **60,** 127.

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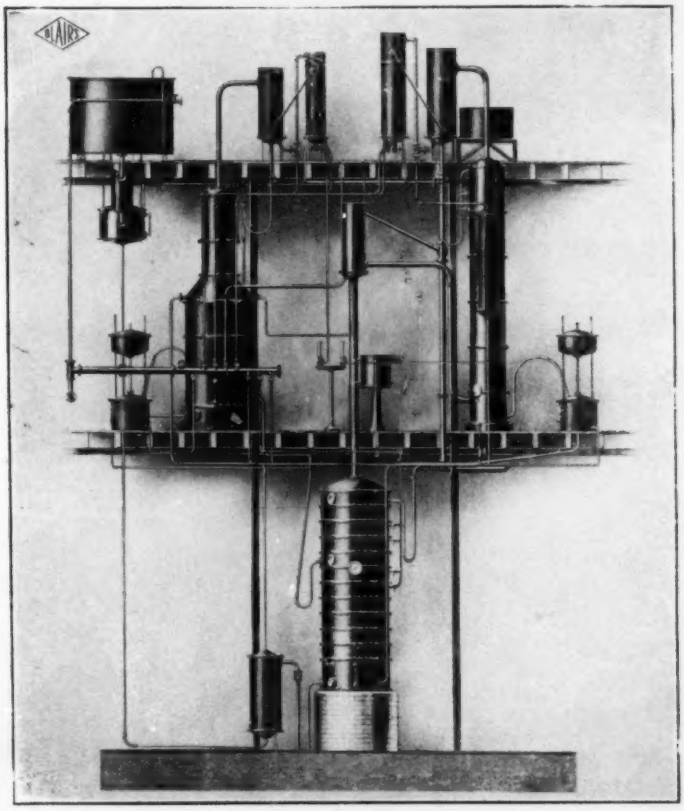

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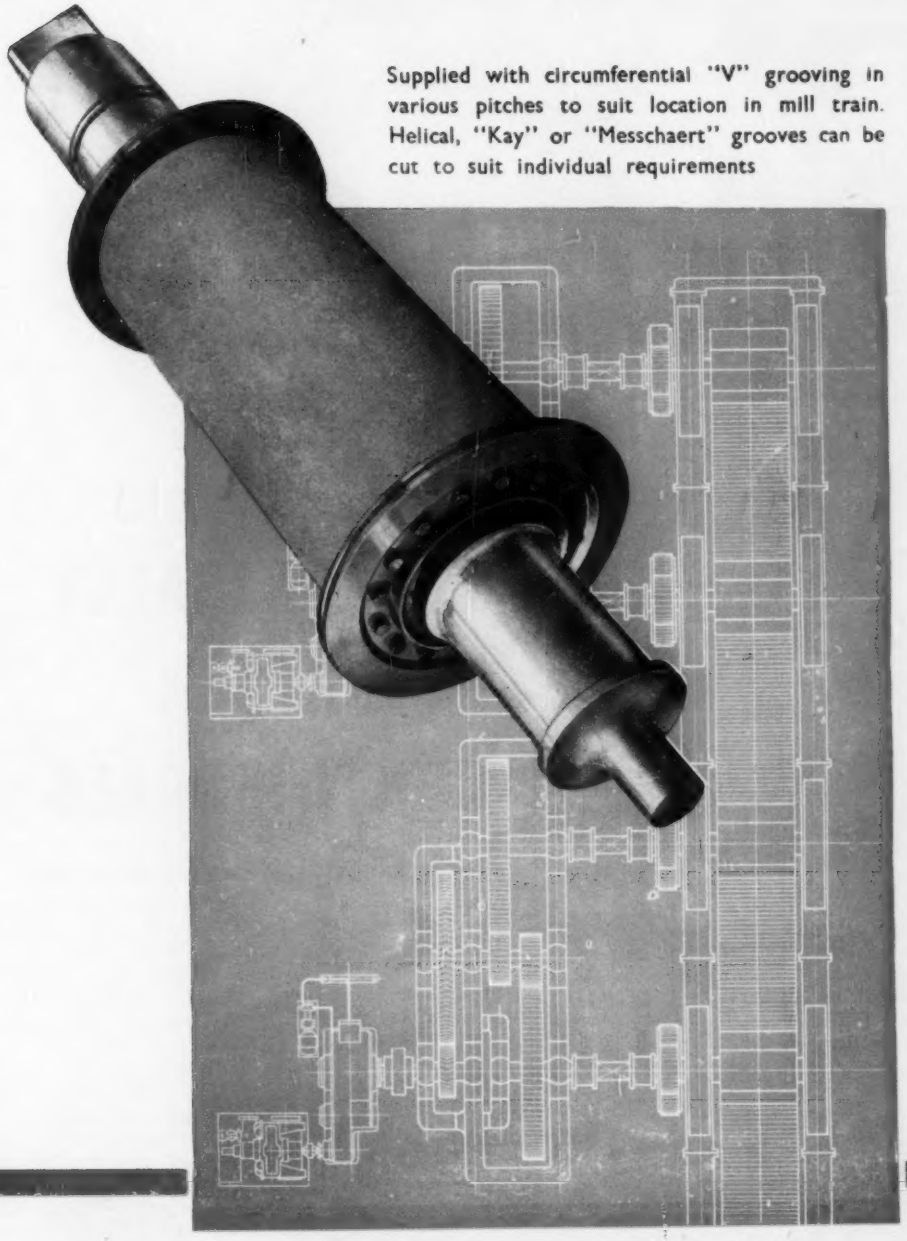

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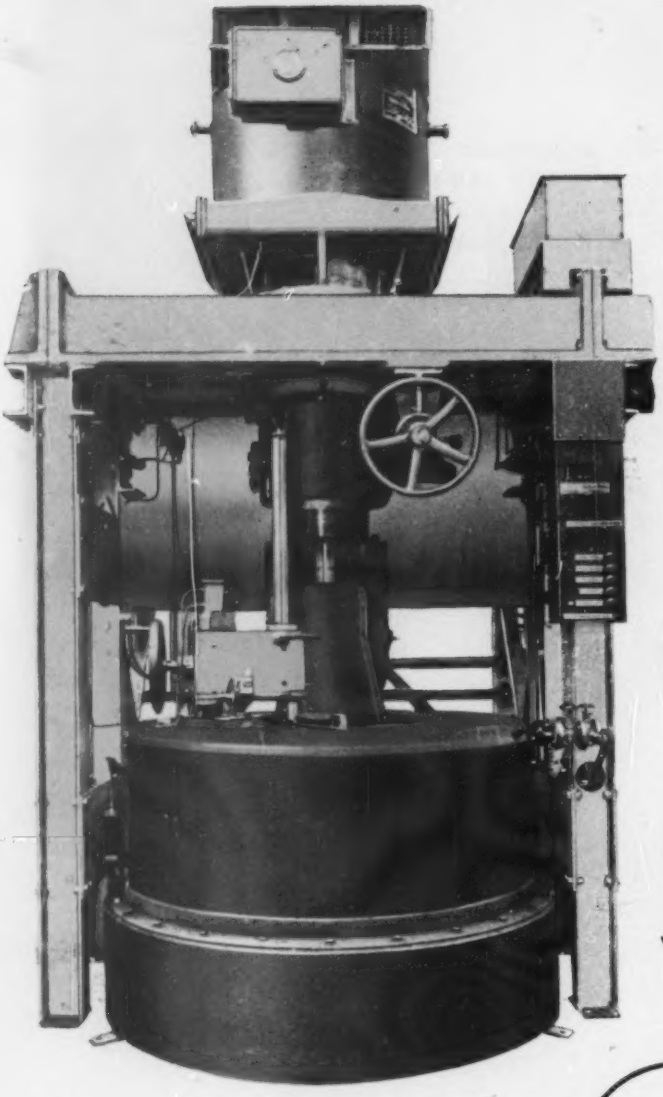

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* * *

Insect pests of sugar cane. I. The root borer, *Emmalocera depressella*. B. D. GUPTA. *Indian Sugar*, 1959, **8**, 775–782.—The article presents a detailed account of the taxonomy, life-history, alternate hosts, natural enemies and control measures.

* * *

Physiologic specialization of red rot pathogen. KIRTI KAR. *Indian Sugar*, 1959, **8**, 797–799.—Evidence is given of the existence of isolates of *Colletotrichum falcatum* with different pathogenic reactions.

* * *

Studies in Saccharum spontaneum. The flowering behaviour of latitudinally displaced populations. R. R. PANJE and K. SRINIVASAN. *Botanical Gazette*, 1959, **120**, (4), 193–202.—An account is given of flowering behaviour of about 340 clones of *Saccharum spontaneum* collected from all over the Indian Subcontinent and grown together at Coimbatore and at Karnal, and studied over a period of six years. A map shows the calculated time of flowering of the clones in their original habitats. At Coimbatore some clones from northern regions failed to flower altogether, or flowered very little. Clones from areas of high rainfall, like Assam and Nepal, also failed to flower when established at Coimbatore and Karnal. This work is considered to have possible applications in cane hybridation work with *Saccharum spontaneum*.

* * *

The value of fodder cane. K. J. MEAD and J. B. NOONAN. *Agric. Gaz. New South Wales*, 1959, **70**, (6), 296–299.—Fodder cane or cow cane are the names used on the north coast of New South Wales for the many varieties of sugar cane grown for fodder, several being local selections. The varieties "Pindar" and "40 S N 5819" are now recommended, being disease resistant. Descriptions of them are given. Both varieties yield well and ratoon satisfactorily and are palatable to stock, although not so leafy as some of the older types. Fodder cane has proved especially valuable to cattle during winter pasture. shortage, in times of drought and in flood stricken areas. It is recommended that one to one and a half acres should be established for every fifteen head of stock carried.

* * *

Polyploids of sugar beet. J. RASMUSSON. *Genetica Agraria*, 1959, **11**, (2), 46–64.—The author carried out his work at the Hilleshög Sugar Beet Breeding Institute in Sweden and refers to similar work in Holland, Belgium, France and northern Italy. The results of field trials with the best diploid and tetraploid sugar beet strains, their triploids and their bulk crosses, are discussed. The following factors were studied—tons of beet per hectare, sugar content, kg of sugar per hectare, "noxious" nitrogen per 100 g of sugar, K + N per 100 g of sugar and bolting tendency. In general there was little difference in yield between diploid and tetraploid strains, the latter being slightly superior. The latter also showed considerably less tendency to bolt. The production of tetraploid or "polyploid" seed on a large scale presents certain slight difficulties in that tetraploids develop somewhat slower that diploids and produce less pollen, but these difficulties have been overcome.

* * *

Sugar cane in Uganda. ANON. *Ann. Rpt., Dept. Agric., Uganda*, 1957, 16.—A total of 16,681 acres of mature cane was harvested during the year and sugar production from the two estates was 80,774 tons, which surpassed last year's record production by over 11,000 tons. Exports to Kenya and Tanganyika totalled 22,844 tons, compared with 12,993 tons in 1956.

* * *

Rocking rakes for early cultivation. C. G. STORY. *Cane Growers Quarterly Bull.*, 1959, **23**, 4, 5.—Vertical tines, from 2 to 7 per gang and with 3 to 7 gangs forming a unit, are driven with a rocking motion caused by cams driven from the tractor. Situated directly over the cane row, the rake can be used immediately after planting to remedy faulty land preparation or to break compaction caused by heavy rain

* * *

Insecticide experiments against wireworms. A. A. MATTHEWS. *Cane Growers Quarterly Bull.*, 1959, **23**, 6–8.—"Lindane", "Aldrin" and crude BHC, when mixed with the fertilizer, all gave good control as measured by number of primary shoots per 10 chain row, whether the mixture was applied direct to the setts or indirectly after the setts were covered by 2 inches of soil.

* * *

Q 68. C. G. STORY. *Cane Growers Quarterly Bull.*, 1959, **23**, 10–12.—A description of this variety and a comparison with Q 50 are given. It is a cross, POJ 2878 × Co 290, selected in 1946, given a Q number in 1957 and released for the Mackay and Proserpine areas in 1959.

* * *

Q 66 in the Mulgrave area. P. VOLP. *Cane Growers Quarterly Bull.*, 1959, **23**, 21.—Q 66 was approved in 1957 as particularly suited vegetatively for the rich river flats. Unfortunately it is susceptible to chlorotic streak and leaf scald, but should continue to be superior to other varieties with care in the selection of planting material.

* * *

Nitrogen—from a green manure crop. L. G. VALLANCE. *Cane Growers Quarterly Bull.*, 1959, **23**, 26.—A replicated experiment is described in which a cowpea and velvet bean mixture was ploughed in, and sulphate of ammonia dressings of 1·5 and 3 cwt were applied. These dressings combined were also compared. The fractional differences in yield of all dressings both of cane and sugar were insignificant.

AN ESTIMATION OF THE MOLECULAR WEIGHT OF THE DIALYSED BROWNING PRODUCTS FROM CANE FINAL MOLASSES

By W. W. BINKLEY

(New York Sugar Trade Laboratory, 37 Warren Street, New York 7, N.Y., U.S.A.)

A SURPRISINGLY intricate polymer can be obtained from the reaction of a simple amino-acid with a simple reducing sugar. The complexity of the polymer(s) formed in the production of raw cane sugar is expectedly greater. In this instance there is available in the crusher juices approximately a dozen amino-acids[1], each capable of polymerization with the rather abundant constituent hexoses, D-glucose and D-fructose.

Some indications of the complexity of polymers are usually revealed in molecular weight studies. The results from some methods suggest also certain structural features. Application of these techniques to more or less specific melanoidins has been infrequent and inconclusive[2]. In continuation of our research on the cane molasses "browning" polymer, we wish to report herein the results of certain of our dialysis, ultracentrifugation, and viscosity studies relevant to this polymer.

EXPERIMENTAL

Calibration of Cellulosic Membrane

An aqueous solution containing about 1% of one of the substances of known molecular weight was poured into a membrane bag made from a 20 to 26 inches length of cellulosic tubing of 2·25 inches dia. and 0·0023 inch wall thickness (Central Scientific Co., Chicago, Illinios, U.S.A.). Just prior to the beginning of the dialysis, aliquots of the solution were taken for the subsequent determination of the solute concentration. The contents of the membrane bag, saturated with toluene and continuously stirred mechanically, were dialysed against toluene-saturated demineralized water in an apparatus which permitted the complete change every 2 hr of the solution outside the bag. Aliquots of the solution inside the bag were removed at selected intervals. The solute content was obtained by partially dewatering the aliquot by freeze-drying followed by drying the residue at 25°C over phosphoric anhydride under reduced pressure. The substances dialysed were protamine sulphate (M.W. 8000), lysozyme (14,000), trypsin (20,000) and ovomucoid (28,000). Analytical data are presented in Figs. 1 and 2; ovomucoid was retained by the membrane.

Isolation of the Molasses "Browning" Polymer

Twenty grams of Florida final molasses[3] were dissolved in 500 ml of distilled water and the resulting solution was saturated with toluene. This mixture was dialysed against toluene-saturated demineralized water for 96 hr in the apparatus used in the calibration of the membrane bag. The solution of dialysed polymer was concentrated under reduced pressure at 50–60°C to a volume of about 100 ml and the resulting concentrate was filtered and then stored at —20 to —25°C. Five of these polymer concentrates were combined; saturated with toluene, dialysed and concentrated in the same way as each of the 20 g portions of the final molasses. The yield of redialysed polymer after partial dewatering by freeze-drying was 2·91 g. A solution of 1 g of this polymer in 50 ml of distilled water was allowed to pass through a thin bed of diatomaceous earth ("Celite" Analytical Filter-Aid,

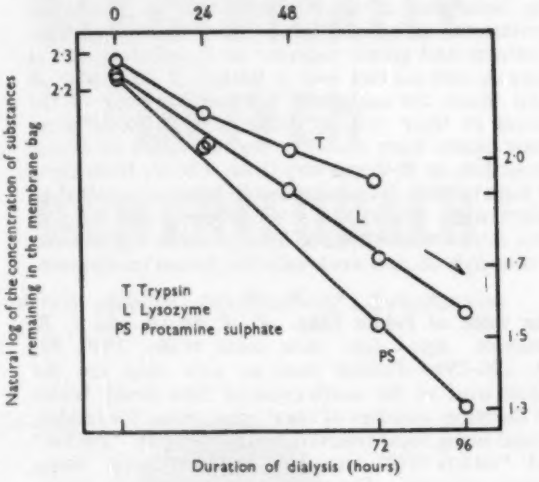

Fig. 1

Johns-Manville, New York, N.Y., U.S.A.) supported by a filter disc (pore size 0·1 microns, Millipore Filter Corp., Watertown, Mass., U.S.A.). The optically-clear filtrate was dewatered partially by freeze-drying; final drying was achieved with phosphoric anhydride under reduced pressure at 25°C. The clarified product was used in the estimation of the molecular weight of the polymer.

DATA FOR THE ESTIMATION OF THE MOLECULAR WEIGHT OF THE MOLASSES "BROWNING" POLYMER

(A) *Viscosity Data.*—The solvent for the polymer in these measurements was 0·20*M* sodium chloride

[1] KOWKABANY *et al.*: *J. Agric. Food Chem.*, 1953, **1**, 84.
[2] LANGER: *Ph.D. Dissertation* (Ohio State University), 1951.
[3] Kindly supplied by the United States Sugar Corp., Clewiston, Fla., U.S.A.

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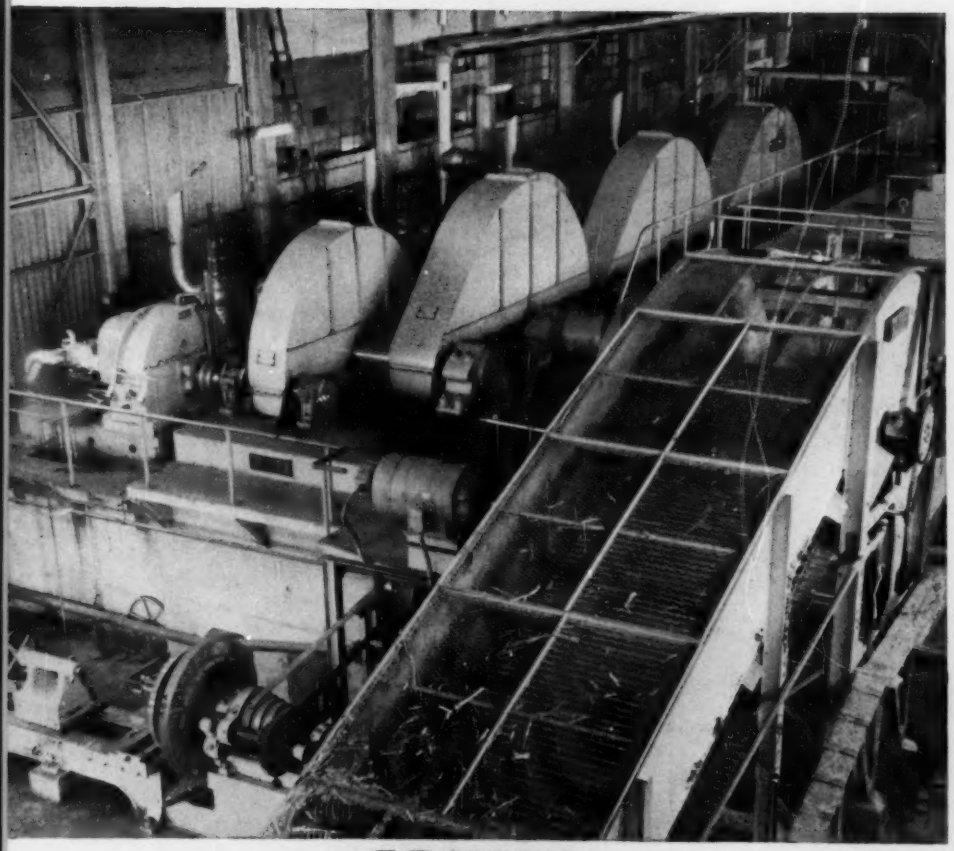

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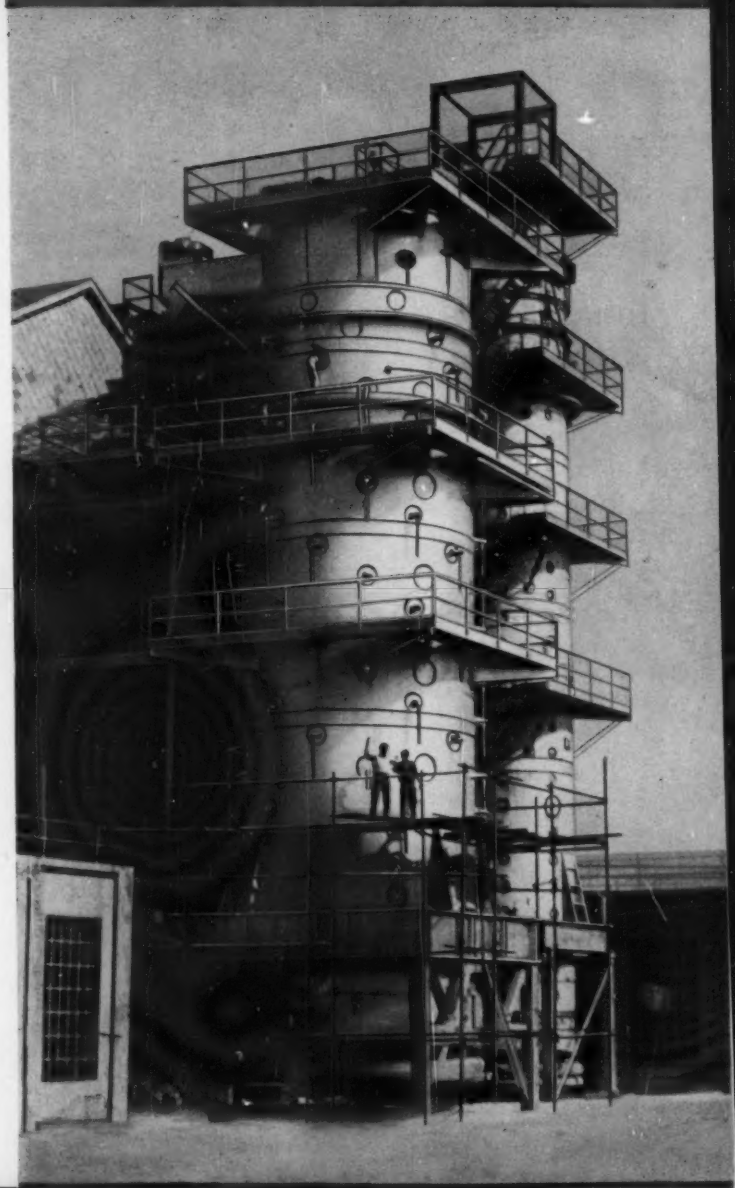

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in water. The concentration of the polymer was varied from 2·3 to 4·6 mg/ml of saline solution (expressed in Figs. 3 and 4 as g/100 ml). The viscosities of these polymer solutions at 29°C were determined in an Ubbelohde dilution viscometer (Fisher Scientific Co., New York, N.Y., U.S.A.) and these results are shown in Fig. 3. The intrinsic viscosity of the polymer was found by extrapolation (concentration approaching zero, c→0) to be 0·171 dl/g. The viscosity of the solvent alone at 30°C was found to be $1{\cdot}01 \times 10^{-2}$ poises.

(B) *Sedimentation Data.*—The sedimentation constants for the polymer solutions were obtained with a Spinco ultracentrifuge, Model E, and a No. 5090 valve-type synthetic boundary cell (Spinco Division, Beckman Instrument Co., Palo Alto, Calif., U.S.A.). The ultracentrifuge was operated at a speed of 59,780 r.p.m. which produced a centrifugal force of 260,000 g. The duration of each centrifuging was approximately 1·5 hr. The sedimentation constants for the polymer at three concentrations (2·3, 3·45 and 4·6 mg/ml in 0·20 *M* NaCl) were calculated from the photographic plates recording the progress of the respective ultracentrifugations. These data are assembled in Fig. 4. The sedimentation constant for the polymer was found by extrapolation (c→0) to be $2{\cdot}6 \times 10^{-13}$ cm/g-sec at 20°C.

(C) *Partial Specific Volume Data.*—The apparent specific volume was obtained from the densities of the solution (1·0205 g/ml) and the solvent (1·0137 g/ml) at 30°C as determined pycnometrically from a 0·345% solution of the polymer in 0·20 *M* sodium chloride in water; it was found to be 0·61 ml/g. [If the apparent specific volume is assumed to be independent of the polymer concentration, the apparent specific volume is equal to the partial specific volume[4]. This value (0·61) was low in comparison with that for most proteins (0·70–0·75); however, it was in line with the partial specific volumes found for cellulose derivatives and other polysaccharides[5].]

Calculations

(A) *Huggins'[6] constant for the molasses "browning" polymer.*—Huggins' constant (*k'*) was obtained from the data in Fig. 3 and the following equation:

$$\frac{\eta_{sp}}{c} = [\eta] + k'[\eta]^2 c$$

for 0·345% polymer solution,

$$0{\cdot}180 = 0{\cdot}171 + k'(0{\cdot}171)^2 \times 0{\cdot}345$$

$$k' = \frac{0{\cdot}180 - 0{\cdot}171}{0{\cdot}0292 \times 0{\cdot}345} = 0{\cdot}90$$

$\frac{\eta_{sp}}{c} = \frac{\text{Specific viscosity}}{\text{Concentration, g/100 ml}}$ = Reduced viscosity

$[\eta]$ = Intrinsic viscosity (c→0) = 0·171 dl/g

c = Concentration, g/100 ml

(B) *Molecular weight of the molasses "browning" polymer.*—The following formula was used in this calculation on the basis of the Flory-Mandelkern assumptions[7]:

$$M^{2/3} = \frac{S^{\circ}[\eta]^{1/3}\eta_o N}{2{\cdot}5 \times 10^6 \ (1 - v\rho)}$$

$$M^{2/3} = \frac{2{\cdot}6 \times 10^{-13} \times 0{\cdot}555 \times 1{\cdot}01 \times 10^{-2} \times 6{\cdot}023 \times 10^{23}}{2{\cdot}5 \times 10^6 \ (1 - 0{\cdot}61)}$$

$$M^{2/3} = \frac{8{\cdot}78 \times 10^8}{9{\cdot}75 \times 10^5} = 900$$

$$\log M = 1{\cdot}5 \log 900 = 4{\cdot}4316$$

$$M = 27{,}000 \pm 1{,}000$$

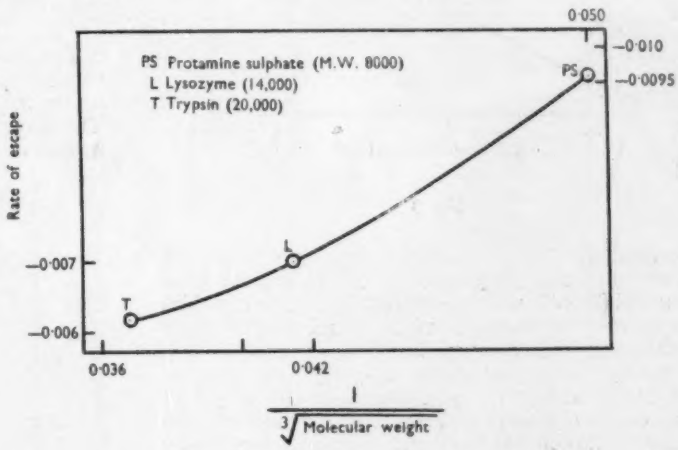


Fig. 2

M = Molecular weight

S° = Sedimentation constant at c→0 for the polymer at 20°C = $2{\cdot}6 \times 10^{-13}$

$[\eta]$ = Intrinsic viscosity at c→0 = 0·171

η_o = Viscosity of solvent at 20°C = $1{\cdot}01 \times 10^{-2}$

N = Avogadro's number = $6{\cdot}023 \times 10^{23}$

ρ = Density of solvent at 20°C = 1·0

v = Partial specific volume of the polymer = 0·61

Results and Discussion

The merits of using dialysis in the isolation of the molasses "browning" polymer have been discussed previously[8]. The selection of the membrane was based upon high permeability to low molecular weight substances, such as amino-acids, salts and simple sugars, and high retentivity for melanoidins. Further characterization of the membrane has been undertaken. Four proteins ranging from 8,000 to

[4] Schachman: "Methods in Enzymology", *Ultracentrifugation, Diffusion and Viscometry*, 1957, **4**, 32.
[5] Farber: *Ph.D. Dissertation*, (Polytechnic Institute of Brooklyn). 1959.
[6] *J. Amer. Chem. Soc.*, 1942, **64**, 2716.
[7] *J. Chem. Physics*, 1952, **20**, 212.
[8] Binkley: *I.S.J.*, 1958, **60**, 165.

28,000 in molecular weight were used to establish the point or range of total exclusion of the membrane. Protamine sulphate (8000), lysozyme (14,000) and trypsin (20,000) passed through membrane; subsequent to the first 24 hours of dialysis, the denaturation of trypsin was appreciable (Fig. 1). The relationship

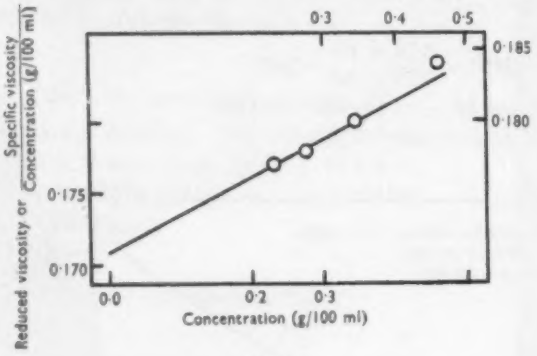


Fig. 3

between the rate of escape of these substances and their molecular weights is shown in Fig. 2. Ovomucoid (28,000) was retained by the membrane. The point of total exclusion of the membrane for these substances was between 20,000 and 28,000. Discounting the relative states of aggregation (proteins vs. melaniodins), the minimum molecular weight of the dialysed molasses "browning" polymer was in excess of 20,000 and its average molecular weight may be less than 28,000.

The data from the viscosity measurements of the molasses polymer (in 0·20 M sodium chloride) was gathered primarily for use in the estimation of the molecular weight of the polymer (Fig. 3). Certain of its characteristics may be deduced also from these data. The concentration dependence of the reduced viscosity, as shown in Fig. 3, illustrates that the particle can not be considered as an impermeable hydrodynamic sphere. This conclusion was also verified by the relatively high value of the Huggins' constant, 0·90 (Calculation A).

The sedimentation rates of the molasses polymer at three concentrations were observed (Fig. 4). Photographs of the progress of the settling indicated that the measurements were being made on a brown substance(s) which was polymeric. The spreading of the sedimenting boundary was too large to be explained by diffusion alone and indicated the polydispersity of this sample of the molasses polymer.

A polymer model assuming a random chain configuration has been selected for the following reasons:

1. The concentration dependence of the reduced viscosity negated a model based on an impermeable sphere.

2. The small value of the intrinsic viscosity, 0·171, appeared to rule out the possibility of assuming a model based on a rigid rod.

3. A random chain configuration has been established for nearly all types of polysaccharides and their derivatives.

The theory deriving molecular weights from intrinsic viscosity and ultracentrifugation data of random coil polymers has been set forth by FLORY and MANDELKERN[7]. Using their equations, the molecular weight of the cane molasses dialysed "browning" polymer was found to be 27,000 $\pm$ 1000 (Calculation B).

SUMMARY

The molecular weight of the dialysed molasses "browning" polymer was found to be 27,000 $\pm$1000 on the basis of viscosity and ultracentrifugation data. The shape of the polymer was deduced to be closest to that of a random coil.

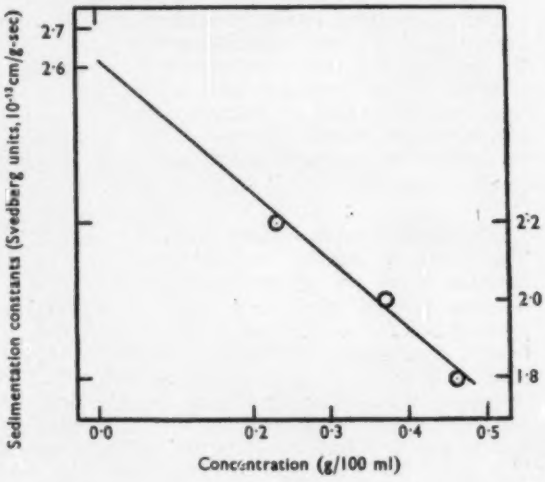


Fig. 4

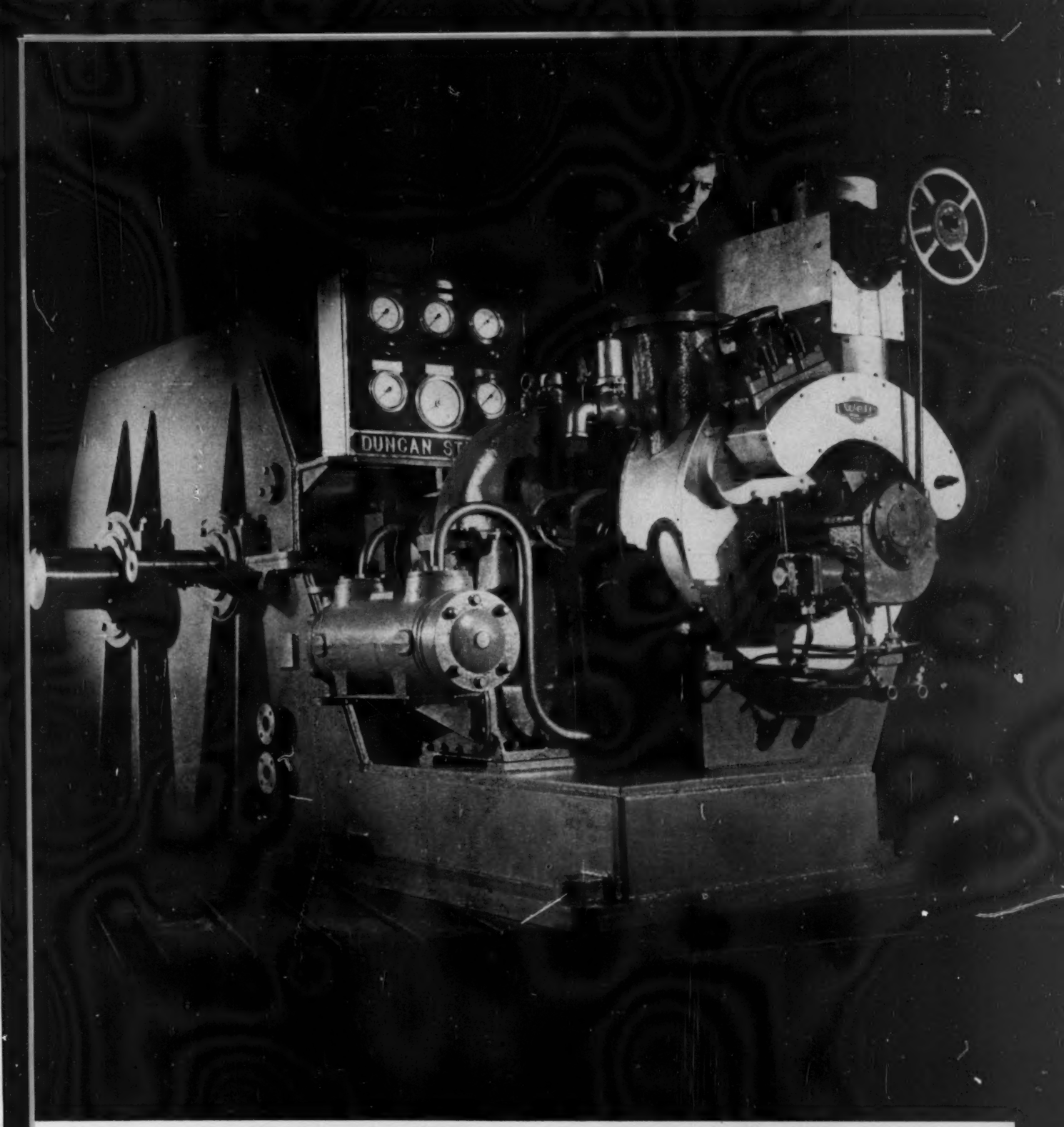
ACKNOWLEDGMENT

The assistance of Dr. ELLIOTT FARBER* with the experimental work and preparation of the manuscript is gratefully acknowledged.

* Present Address: Texaco Research Center, Beacon, New York, U.S.A.

Sudan-U.A.R. trade agreement[1].—Under a recent trade agreement, the United Arab Republic will supply 40,000 tons of refined and white sugar to the Sudan during November 1959—April 1960. The price to be paid for refined sugar will be the equivalent of £36. 8s. 4d. per metric ton, c. & f., with a discount for whites of slightly more than £2.

[1] C. Czarnikow Ltd., *Sugar Review*, 1959, (432), 191.



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By L. A. TROMP, A.M.I.Mech.E.

PART I.

CANE cutting is not normally done during the night for obvious reasons and thus loading of the transporting equipment as well as cane conveyance is then stopped in most countries.

It is thus necessary to store the cane during the day time, so that the grinding can proceed at night without interruption through lack of cane. A further advantage of cane storage facilities is the ability to unload the transporting equipment when the mills are stopped for repair or other reasons while the former can continue operations.

There are various ways to accomplish cane storage, viz. :

(a) storage in railroad cars, carts, trucks or trailers ;

(b) storage in bulk or bundles in the free air by a derrick crane ; and

(c) storage in bundles by a travelling crane, normally having a shed over the gantry or runway, or by a monorail hoist or trolley.

Storage in Cars

On those sugar cane plantations which have no network of good roads and where the topography is of a rolling nature, the use of the existing plantation railroad may be compulsory; this applies especially to countries such as the northern states of Brazil. It so happens that lately, as a result of increased grinding rates, there is a shortage of rolling stock, i.e. the storage capacity therein has become insufficient and other means have to be applied to meet the deficiency.

Furthermore, where trucks—often owned by local contractors—are used for cane transportation, quick unloading will allow more round trips to the fields, thus cutting operator expenses. In Fig. 1 is shown how the cane arrives at the mill—rather slow in the morning and increasing after midday, reaching its maximum towards the end of the day. When the cane has been stored during the night in railroad cars or other carriages, the factory yard is filled with empty equipment in the morning, which has to be rushed to the fields for re-loading. Obviously a more efficient scheme is to unload the cars, etc. as soon as these arrive, so they can be returned to the fields in the afternoon or the early hours of the night, which will reduce greatly the number of cars required.

In those countries where the cane is transported in huge trailers, direct unloading by means of a chain net within the trailer cage and lifted by a special hoist will be required, but the storage of cane thus unloaded is cumbersome, as it cannot be piled.

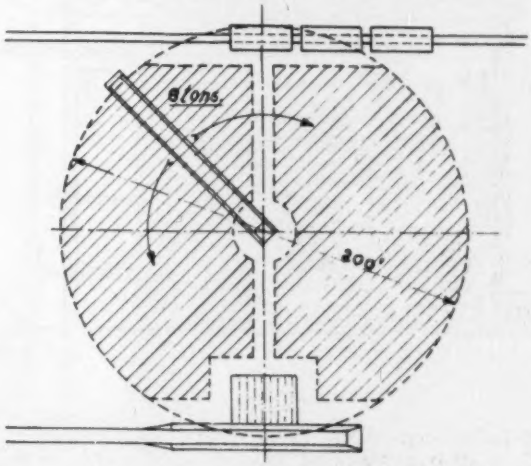

Fig. 2

Storage by a Derrick Crane

Where the derrick crane is used for storage, the large size normally is applied, having a boom of 100 ft. The crane is not self-supporting but fixed by six steel cable guys, placed at considerable distances, up to about 300 ft, from the crane centre. The storage area of a derrick crane as shown in Fig. 2 is large and since 50% of the described circle, after deduction for traffic lanes and the feed table, may be available for storage, some 15,000 sq. ft. can be covered by cane.

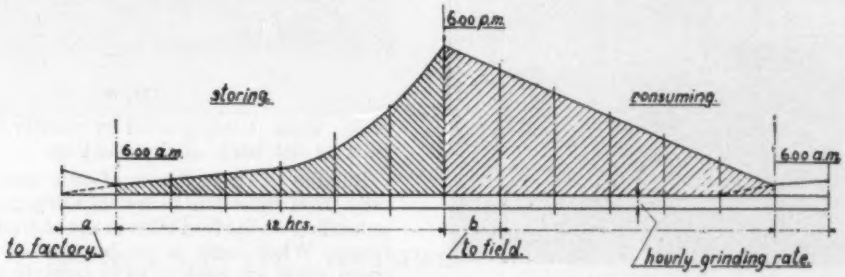

Fig. 1

The horizontal boom is arranged at 50 ft above floor level, so the maximum lifting height may be taken as 40 ft and thus cane can be easily stored 15 ft or higher if so desired. Assuming a density of 25 lb./cu. ft. for bundled or grabbed cane, the storage capacity is calculated as 2000 tons.

Normally the cane arriving at the mill is lifted in bundles by multiple releasing chain or cable strings which are attached to a spreader beam on the hook

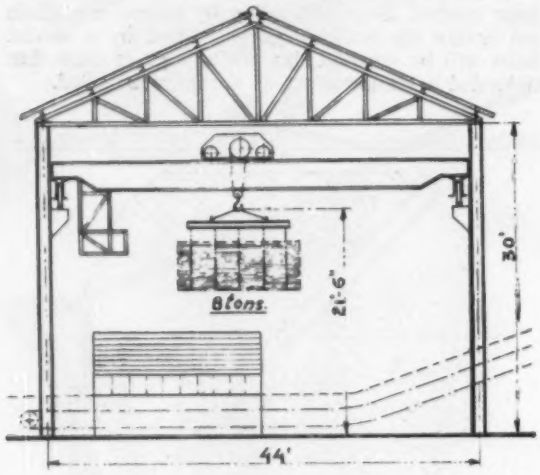

Fig. 3

of the hoisting trolley. From storage to the feed table a cane grab may be used, which is quick in operation but hard on concrete floors and always leaves some cane behind.

Although the lifting capacity is given as 10 tons, about 1900 tons of cane can be stored in a 12 hour shift, when bundles of an average weight of 8 tons are hoisted at a 3 minute loading cycle. When the same

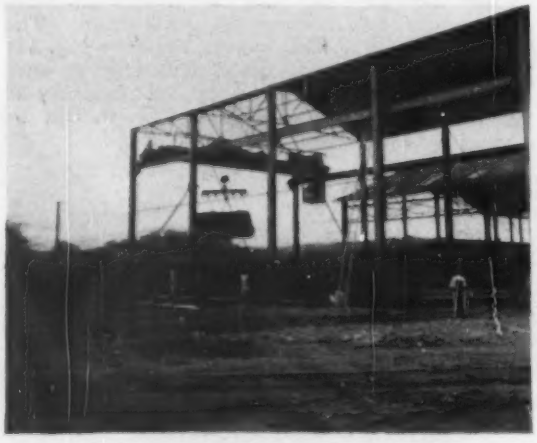

Fig. 4

crane is used for storage as well as for feeding the mill at the same time, the capacity will be only half for feeding and the rest for storage.

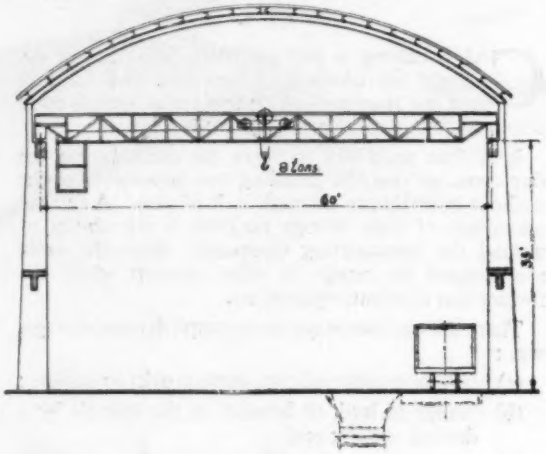

Fig. 5

STORAGE BY TRAVELLING CRANE.

In Fig. 3 is shown a steel cane shed with an electric overhead travelling crane, to be operated from a cabin, while Fig. 4 shows this outfit in actual operation at a Brazilian sugar factory. The shed comprises 4 bays of 44 ft × 22 ft at 30 ft height of the roof trusses and a crane lifting height of 21½ ft from the

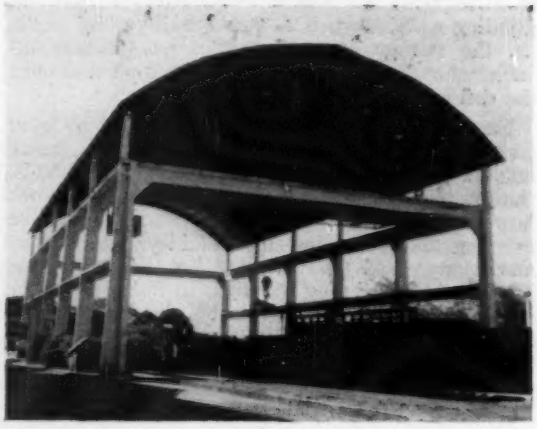

Fig. 6

floor. Cane is transported by railway trucks, which enter at the back of the building.

Bundles of about 8 tons of cane are hoisted integrally from these trucks by releasing chain slings for unloading on the feed table in the second bay from the front. When cane is to be stored, non-releasing chain slings are used, so as to keep the cane bundled. In the front bay bullock carts with a cane weight of

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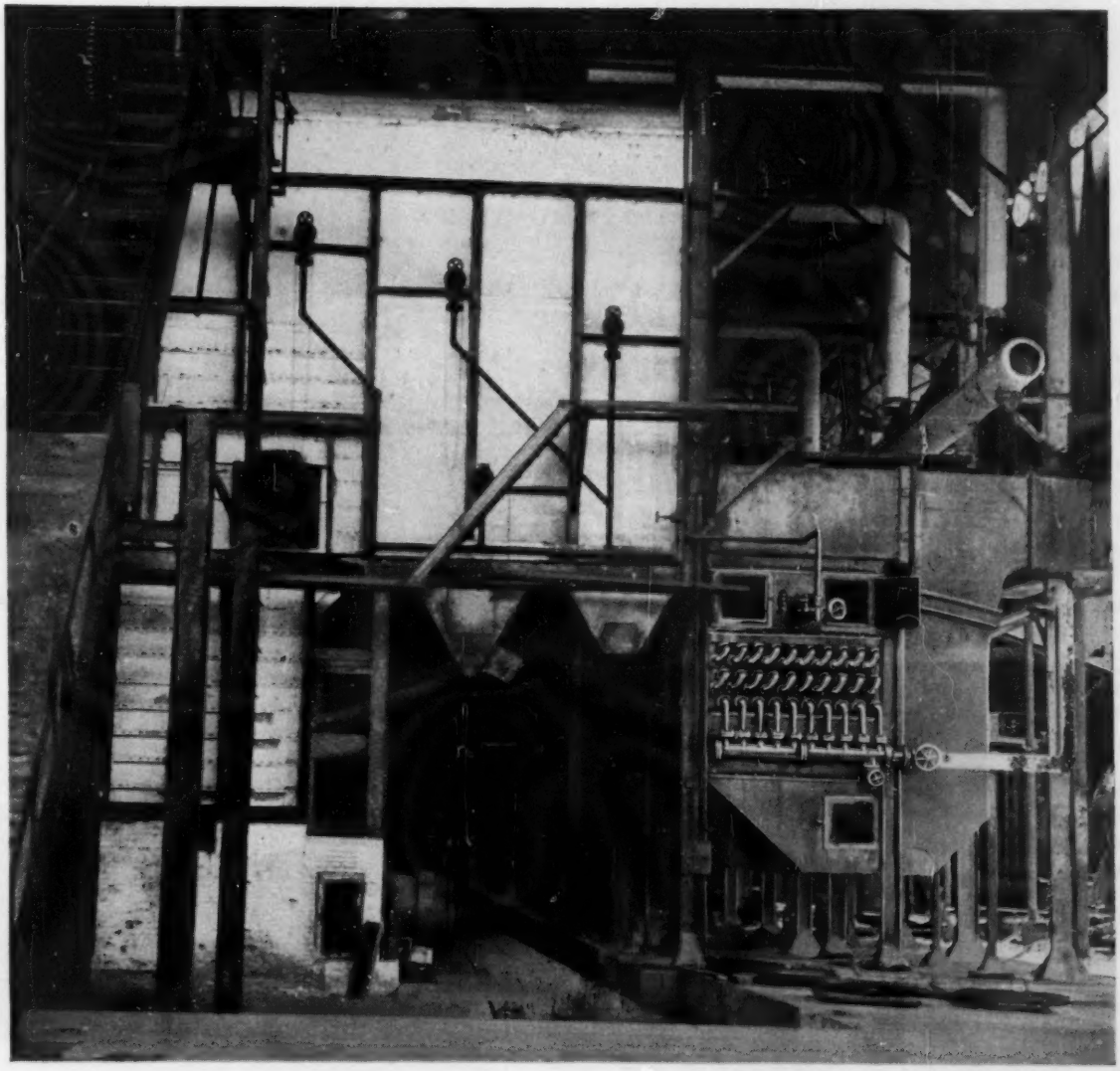

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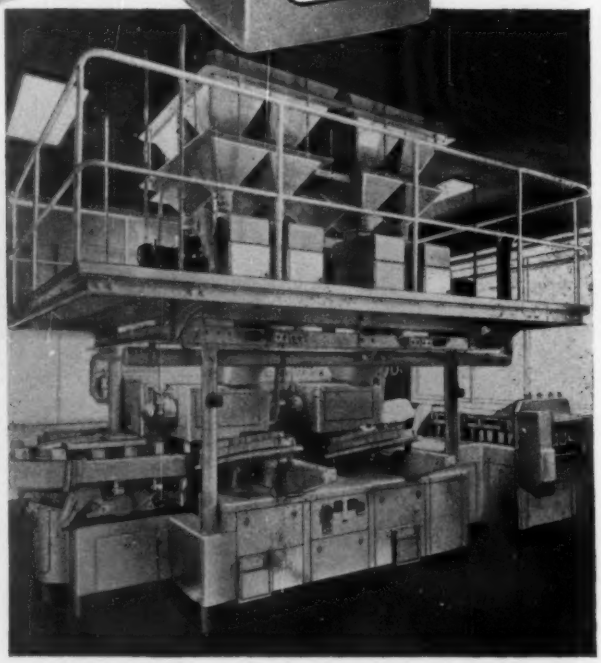

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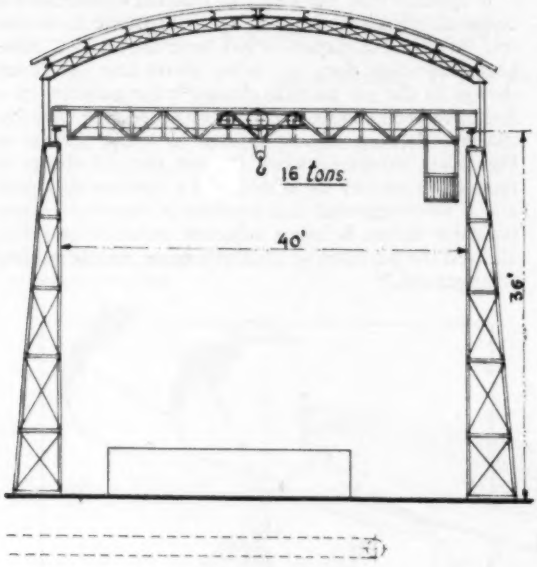

Fig. 7

about 5 tons can be equally and quickly unloaded. The storage capacity of this shed is about 300 tons of cane, but its length can be increased if so required.

A different cane storage shed is shown in Fig. 5 made completely of reinforced concrete construction for which Brazilian engineers are renowned. The shed comprises 5 bays of 60 ft × 26 ft and the electric travelling crane has its gantry 33 ft above floor level. Parallel to one side of the building is the track for the railway trucks which is laid alongside the auxiliary cane carrier. Road trucks with a bundle weight up to about 8 tons can be unloaded as well as the rail trucks. A photograph of such an installation is shown in Fig. 6 where 1000 tons of cane can be stored for the 2000 tons per day capacity of the factory.

An equally very interesting design of cane shed is shown in Fig. 7 constructed of light weight steel by a Brazilian manufacturer. Attention is called to the latticing of the columns, made of round steel bars, welding having been applied throughout of this design. Although the cane bundles have a weight of approximately 12 tons, the lifting capacity of the electric overhead travelling crane is 16 tons. The cane is hauled by a narrow gauge railway and also by motor trucks, each car as well as truck load being lifted in full.

(*To be continued*)

THE EFFECTS OF CALCIUM AND PHOSPHATE IN CANE JUICE CLARIFICATION

By M. C. BENNETT* and J. M. RAGNAUTH‡

Department of Sugar Chemistry and Technology, Imperial College of Tropical Agriculture, Trinidad, W.I.

PART II.

The Nature of Calcium and Phosphate Effects

In previous papers BENNETT[12, 18] has discussed the relationship between flocculation and settling behaviour in cane juice systems; in general an increase in the extent of flocculation is accompanied by an increase in mud volume and an increase in settling rate. Since it was also demonstrated that flocculation is dependent upon, amongst other factors, the phosphate and calcium content of the juice, it is clear that at low phosphate levels the settling behaviour of juices will be extremely sensitive to the quantity of phosphate present. This is well demonstrated here by Fig. 3 which shows that over the range 0–4 mM phosphate precipitated, the sharp decrease in turbidity (i.e. increase in the extent of flocculation) is accompanied by a large increase in both H_∞ and V.

On the other hand, SCHMIDT[18], examining the applicability of the KYNCH[19] theory of sedimentation, has demonstrated that as the quantity of mud increases the settling rate decreases, so that for large additions of phosphate, and hence large quantities of precipitated calcium phosphate, it might be expected that the settling rate will decrease with increasing phosphate content. This type of behaviour accounts for the shape of the settling rate *vs.* phosphate curve shown in Fig. 3; the maximum settling rate is to be expected somewhere in the vicinity of the phosphate content at which flocculation is complete and the turbidity in the clarified juice low. Mud volumes increase with phosphate content over the whole range, though the curve is not linear. The curve apparently levels out over the range 4–10 mM (Fig. 3) and this effect must be attributed to some change in floc structure which occurs when flocculation is complete (i.e. turbidity <0·05).

On the basis of these observations, it would appear that the most desirable phosphate content for lime-heat defecation should lie somewhere between that

[18] *Nature*, 1958, **182**, 1439; *I.S.J.*, 1959, **61**,
[19] *Trans. Faraday Soc.*, 1952, **48**, 166.

at which the settling rate is a maximum and that at which the turbidity has fallen to a value of about 0·05. As will be shown below, the ten cane varieties used in this study gave optimum phosphate contents of around 4 mM, a value close to the accepted value of 300 mg P_2O_5/litre.

The effects shown by calcium in the clarified juice are also shown by other polyvalent cations and the results obtained with Th^{4+}, Ce^{3+} and Mg^{2+} are given in Fig. 5. In order to ensure complete flocculation (i.e. turbidity <0·05) the experiments were carried out at a phosphate content of 7 mM in the presence of 15 mM Ca^{2+} in the clarified juice, a concentration well below the optimum which, in this juice, occurred at 32 mM (the Ca^{2+} result is also shown in Fig. 5 as a dashed curve). It is seen that each peak in settling rate is accompanied by a minimum in the mud volume.

The four sets of results shown in Fig. 5 were obtained over a period of rather less than a month, about two months before the results described in Figs. 3 and 4. It is interesting to compare the positions of the Ca^{2+} peak: Fig. 2 obtained on 13/8/58 shows the peak at 12 mM, Fig. 5 obtained on 17/10/58 shows 32 mM, whilst Fig. 4 obtained on 1/12/58 shows 50 mM. It is possible that the other cations show a similar progression with age of cane in the field.

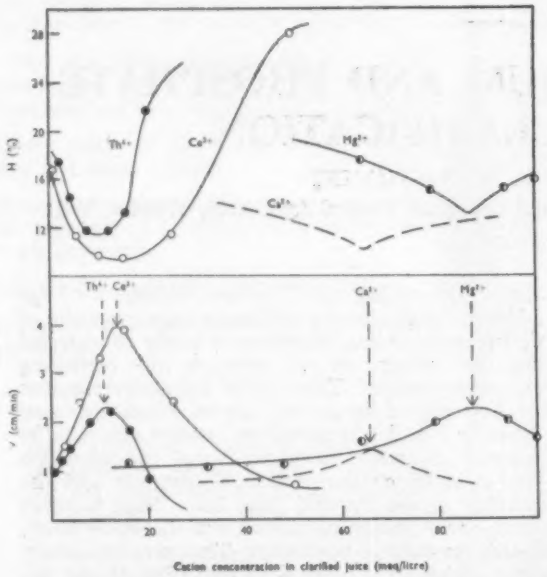

Fig. 5.—The effect of Th^{4+}, Ce^{3+}, Ca^{2+} and Mg^{2+} on the settling of B4098 at a phosphate content of 7 mM.

In Fig. 5 it is seen that the Ca^{2+} peak is sufficiently close to the Mg^{2+} peak to justify the neglect of the low Mg^{2+} content of this juice in the earlier Ca^{2+} experiments: Ca^{2+} concentrations quoted are, as mentioned above, the sum of the Ca^{2+} + Mg^{2+} present.

It appears that the effect of calcium concentration in the clarified juice is probably electrostatic in character. In previous papers is has been shown that lime-heat defecation does not bring about any significant change in the net particle charge[19]; the particles in a floc have been shown to carry an appreciable negative charge. Settling effects similar to those shown in Fig. 5 are produced when the net particle charge is reduced to zero by the addition of a cationic detergent and it was suggested that removal of the electrostatic repulsive forces between adjacent particles in a floc allowed the particles to assume a more closely packed arrangement.[20]

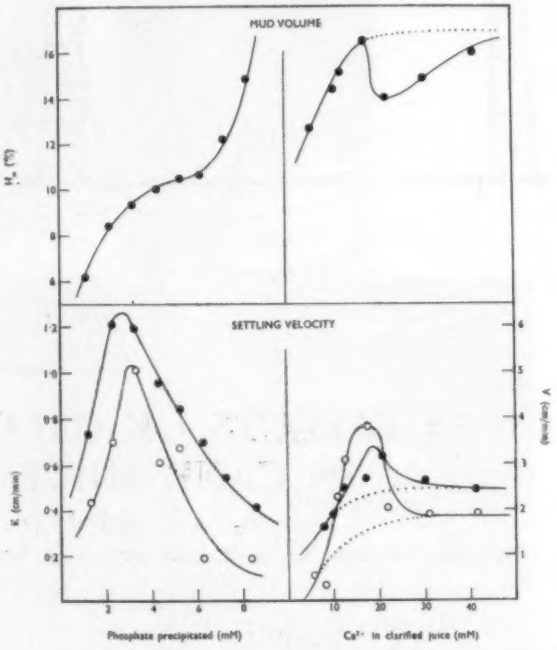

Fig. 6.—The effect of phosphate and calcium concentration in clarified juice on the settling of two normal juices. Phosphate effects in B46218 at a calcium concentration of 22 mM; calcium effects in B45152 at a phosphate content of 5 mM.

However, electrophoretic examination of the charge reversal characteristics of inorganic cations has shown that charge neutralization occurs generally at much higher concentrations than those shown in Fig. 5. In this particular sample of B4098 juice, the charge reversal concentrations of Ce^{3+}, Ca^{2+} and Mg^{2+} were 90, 500 and 900 meq/litre respectively so that from the results expressed in Fig. 5 it is clear that the settling effects described here are definitely not associated with particle charge reversal phenomena.

It seems likely that the electrostatic effects under consideration here concern some other constituent of the flocs; clarification flocs are composed of charged

[20] BENNETT and SCHMIDT: *I.S.J.*, 1959, **61**, 201.

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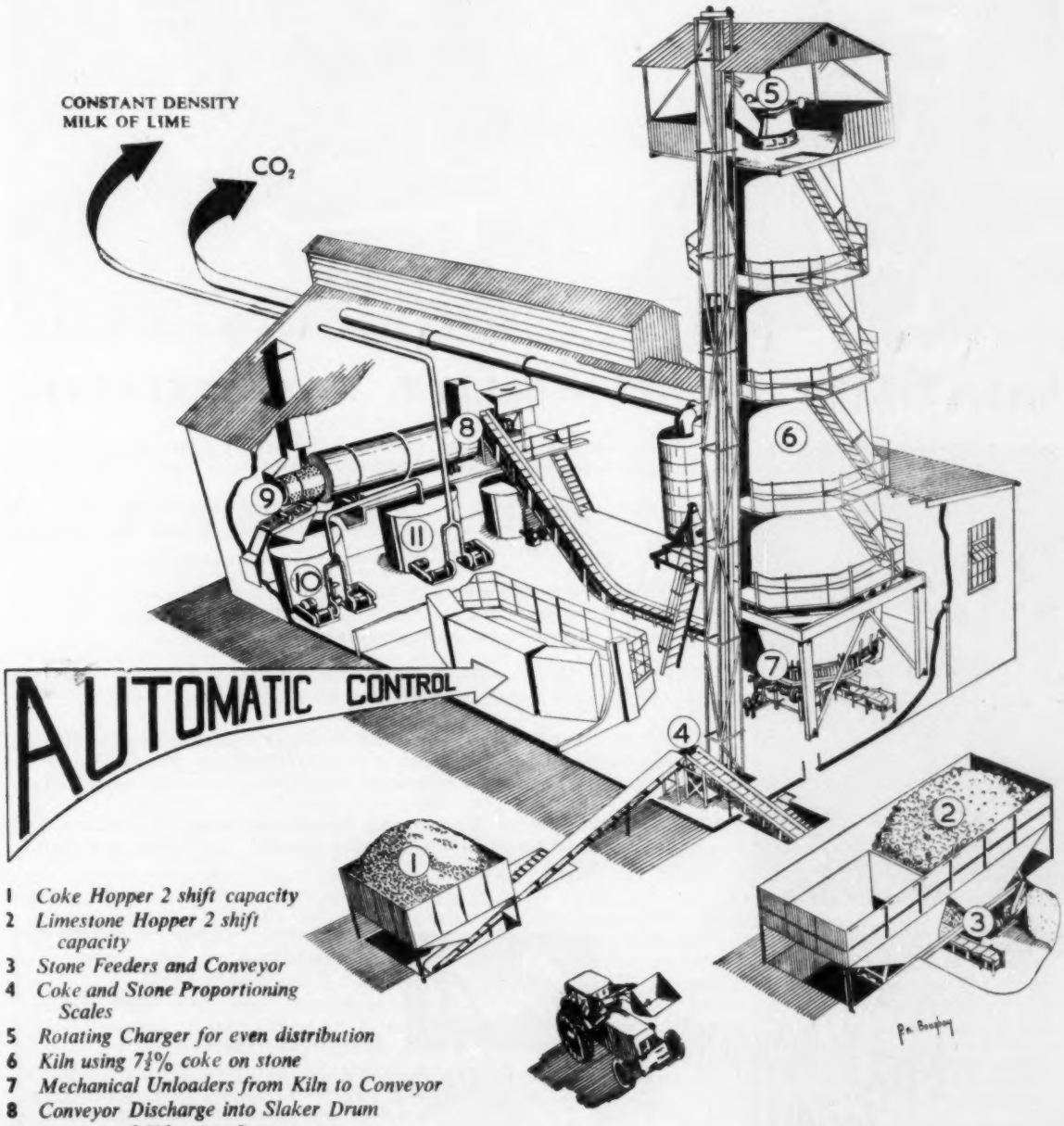

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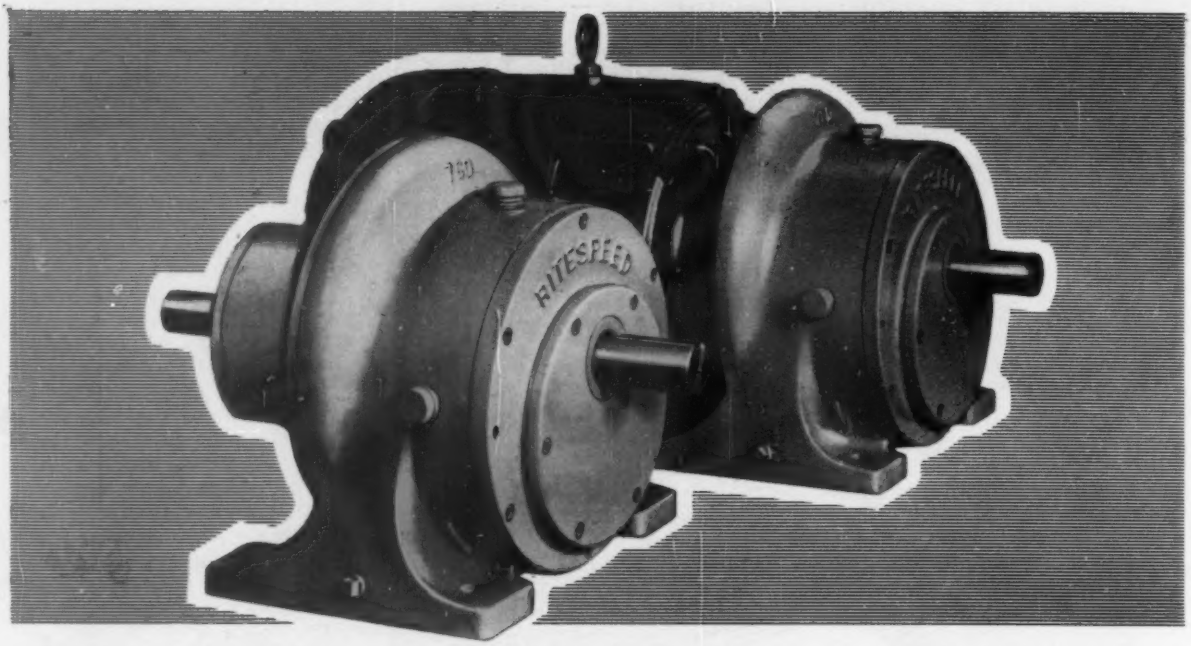

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particles in a matrix containing not only calcium phosphate but also the organic material precipitated on heating and boiling the juice. This organic material, consisting of coagulated protein and polysaccharide, probably comes down as a mucilage which envelopes the particles and thereby forms an intrinsic part of the floc structure developed when the juice is allowed to stand. The presence of this material has been demonstrated by electrophoretic studies on single particles (obtained by breaking up the flocculated system in a

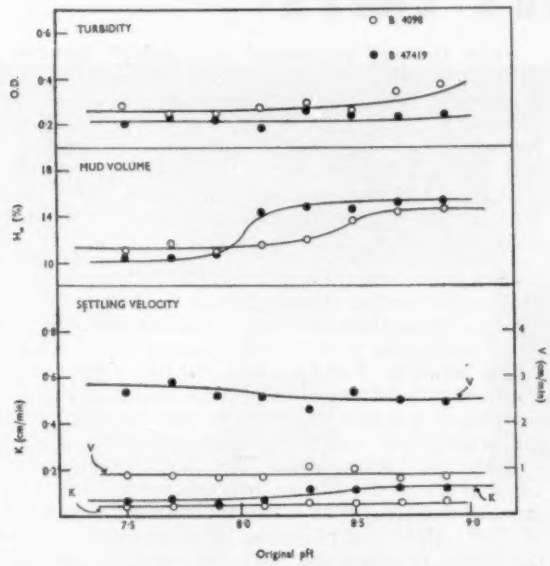

Fig. 7.—The effect of initial ("liming") pH on the settling of B4098 and B47419 at constant phosphate precipitated and constant Ca^{2+} in the clarified juices. B4098: 3·7 mM phosphate, 30 mM Ca^{2+}; B47419: 4·5 mM phosphate, 10 mM Ca^{2+}.

blender) which have shown that the material is itself highly charged[12]. In this B4098 juice, the evidence suggests that the charge originates largely from the carboxylic groups of a high molecular weight polysaccharide of the pectinate type.

While electrophoretic measurements provide information concerning the effect of electrolytes upon the net charge carried by a particle coated with such material, they cannot provide information concerning the molecular changes which occur within the polysaccharide molecule itself. These are associated with the effects of adjacent charged centres (carboxyl groups) upon each other; mutual electrostatic repulsion between charged centres on the same molecule causes the macromolecule to assume an extended configuration. When cations are added, the electrostatic effect of the charged centres is diminished so that the macromolecule collapses into a highly folded configuration, the effect being greatest at the point where the charged centres are just neutralized. Cation additions beyond this point cause re-expansion of the macromolecule, the charged centres now behaving as though they were positive. These electrical changes lead to profound effects on the physical properties of systems containing such charged macromolecules, and are frequently demonstrated by viscosity measurements; for this reason the phenomenon is described as the "electroviscous effect"[21].

However, the concentration of any cation required for the "electroviscous minimum" is often considerably less than the concentration of the same cation required to reverse the net charge of particles coated with the macromolecular substance. With arabinate polysaccharides, it was found[22] that the "electroviscous minimum" concentrations of Ce^{3+}, UO_2^{2+}, Pb^{2+}, Cu^{2+}, Cd^{2+}, Ba^{2+}, Ca^{2+} and Li^{+} are between 2 and 4 times lower than the corresponding charge reversal concentrations, whilst with agar[23] the "electroviscous minimum" concentrations of La^{3+} and Mg^{2+} are more than 10 times lower than the charge reversal concentrations determined electrophoretically[24]. No satisfactory explanation of these differences has yet been found[25].

Returning now to the present work, it must be pointed out that the mucilaginous component of the floc matrix cannot be regarded simply as an adsorbed layer at the surface of particles in the floc; within each floc it forms a continuous mass in which the particles are embedded. It is suggested here that the effect of Ca^{2+} concentration in the clarified juice (the Ca^{2+} concentration with which the floc material is in equilibrium) should be attributed to an "electroviscous" contraction of floc mucilage, which brings about a more closely-packed arrangement of particles within the floc. The change is accompanied by an increase in settling rate and a decrease in mud volume, and it is believed that the maximum settling effect occurs at the "electroviscous minimum" concentration of Ca^{2+}. The magnitude of the settling effect therefore gives some measure of the compressibility of a floc and it is interesting to note that the increases in settling rate obtained here are similar in magnitude to those obtained by changing the net charge carried by the particles using a cationic detergent[20]; interaction between detergent and floc mucilage was probably negligible at the concentrations employed[26].

It is interesting to note that with both Ca^{2+} and Ce^{3+} the cationic effects appear only over a limited range of total phosphate contents, the effects disappearing at high phosphate contents. On the basis of the explanation above it is reasonable to suppose that floc contraction cannot be detected in the presence of large excesses of precipitated calcium phosphate. The effects of cane age are probably associated with changes in the quantity and nature of organic con-

[21] OVERBEEK and BUNGENBURG DE JONG in "Colloid Science", Vol. 2. Ed. KRUYT (Elsevier, Amsterdam.) 1949. p. 203.
[22] HOLLEMAN and BUNGENBURG DE JONG: *Kolloidchem. Beihefte*, 1937, **46**, 113.
[23] KRUYT and BUNGENBURG DE JONG: *Kolloidchem. Beihefte*, 1928, **37**, 1.
[24] Ref. 21, p. 285.
[25] Ref. 21, p. 221.
[26] BENNETT and HAYDON: *J. Colloid Sci.*, in press.

Table I.

Settling behaviour and turbidity features of nine different juices.

Juice	$V_{max.}$		H_{∞} min		O.D. = 0·05	
B37172	3·2 mM PO_4	22 mM Ca^{2+}	28 mM Ca^{2+}		6·1 mM PO_4	15 mM Ca^{2+}
B37161(i)	3·5 ..	20 ..	— ..		5·5 ..	23
B46102	3·0 ..	22 ..	19 ..		5·0 ..	30
B46218	3·5 ..	22 ..	30 ..		4·2 ..	30
B45152	4·0 ..	20 ..	22 ..		5·0 ..	10
B37161(ii)	<4·0 ..	22 ..	22 ..		5·1 ..	18
B4744	<4·0 ..	31 ..	31 ..		4·5 ..	20
B47419	— ..	12 ..	— ..		— ..	10
Ajax.....	— ..	17·5 ..	19 ..		— ..	20

stituents precipitated during the clarification process; this is consistent with the results described in previous papers[13, 20].

Ca^{2+} and Phosphate Effects in Normal Juices

As mentioned above, the B4098 juice used in this study was extremely refractory and it was therefore desirable to examine the effect of phosphate and calcium in normal juices. The effects on settling behaviour of changes in the total phosphate content and in the Ca^{2+} concentration of the clarified juice were studied in nine different juice samples (see Experimental) and the results obtained with two of these juices are shown in Fig. 6. It is seen that the results obtained with B 4098 (Figs. 2, 3 and 4) are also of this form. On the basis of the evidence given above, it is suggested that the electrostatic floc contraction effect should be regarded as being superimposed upon a more gradual change of settling properties with Ca^{2+} level, as shown by the dotted curves.

In general, these phosphate and calcium effects were found with all nine juices though, in some cases, one or other of the effects was less well-defined than those shown in Fig. 6. The positions of the salient features of the curves obtained from each juice are specified in the table below :

From Table 1 it is seen that the phosphate and calcium levels for optimum settling behaviour are not necessarily those for perfect clarity; nevertheless the concentrations quoted lie well within the range of those which occur either naturally or during the commercial clarification process. It appears that the accepted minimum phosphate content for satisfactory clarification (300 mg.P_2O_5/litre) lies somewhere between the $V_{max.}$ phosphate level and the O.D. = 0·05 phosphate level for the nine normal juices studied here.

The Effects of Liming

Whilst the phosphate content of a juice is generally adjusted in the commercial process by addition of phosphoric acid, the Ca^{2+} content of the clarified juice is not subject to any control. In fact, it will be determined by :

(a) the Ca^{2+} content of the mixed juice,
(b) the quantity of phosphate precipitated,
(c) the quantity of lime added.

From the well established relationship[27] between liming pH and Ca^{2+} content of the clarified juice it is clear that adjustment of the liming pH affords a method by which the Ca^{2+} content of the clarified juice may be adjusted; the question then follows: is it the variation in pH or the variation in Ca^{2+} content of the clarified juice which accounts for the differences in settling behaviour observed at different liming pH values ?

In order to study the effect of pH, settling experiments were carried out at constant Ca^{2+} concentrations in the clarified juice and at constant total phosphate levels, the original (i.e. "liming") pH being varied between 7·5 and 9·0 with NaOH. The results obtained with B4098 and B47419 are shown in Fig. 7 from which it is seen that, over the pH range studied, the original pH has no significant effect on either turbidity or settling rate. The mud volumes are constant up to pH 8·0 but between pH 8·0 and 8·5 increase sharply to new constant values. The results of Ca^{2+}, Mg^{2+} and phosphate analyses suggest that the effect is associated with the precipitation of magnesium phosphate. As shown for B4098, the effect is small in juices of low Mg^{2+} but high Ca^{2+} content.

It is therefore concluded that over the pH range 7·5–9·0, pH is not always an important factor in determining clarification behaviour. In all of these juices the optimum clarification conditions were determined largely by the quantity of calcium phosphate precipitated and the calcium content of the clarified juice.

ACKNOWLEDGMENT.

This work forms part of the research programme of the British West Indies Sugar Research Scheme.

Irish Sugar Co. Ltd. Results.[28]–The area devoted to sugar beet increased to 83,593 acres in 1958 compared with 70,923 in the previous year, but owing to the very bad weather conditions the yield of beet and sugar content both suffered, giving a crop of 784,003 tons of beet in the 1958/59 campaign (794,802 in 1957/58) and 102,467 tons of sugar, white value (108,414 in 1957/58). According to latest advices an outturn of some 120–125,000 tons of sugar, white value, is anticipated for the 1959/60 campaign.

[27] Ref. 5, p. 498.
[28] C. Czarnikow Ltd., *Sugar Review*, 1959, (437), 212.

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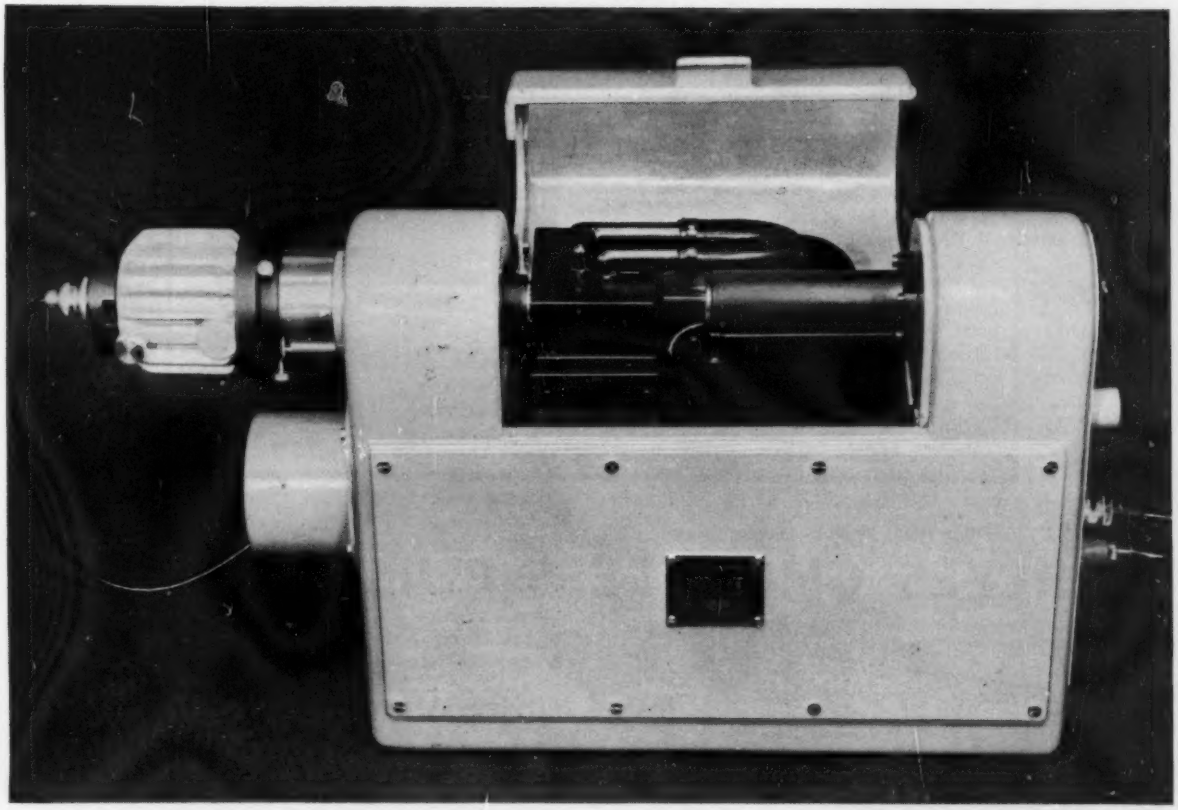

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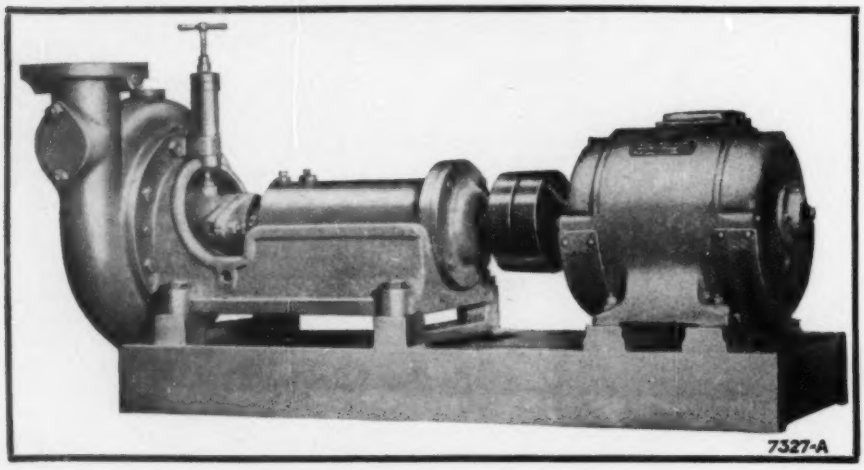

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T.S.C. is improving its filtering operation. C. A LEE. *Taiwan Sugar*, 1959, **6**, (5), 20–23.—Improvements in syrup filtration have been achieved by the use of filter aid, which increased the cycle time, gave an easier-washing cake and lower syrup colour and ash, and saved filter cloth. Synthetic fibre cloths and wire cloths are under test; the latter are of only 60-mesh and give cloudy filtrate, although an 80-mesh cloth might be satisfactory. Sparkler RSC-580 filters have given improved results when replacing presses for syrup and 2nd carbonatation juice filtration, while Vallez filters gave difficulty in pre-coating. Both filter stations were very clean. Other trials under way include a Sparkler unit for 1st carbonatation juice, a Schumacher ceramic candle filter, and a "Stellar" filter supplied by Buckau-Wolf for thin and thick juices.

* * *

A method of settling char cisterns with regulated flow of char and liquor. E. J. GRANT and L. L. MANNING. *Proc. 5th Tech. Session Bone Char*, 1957, 5–20.—The importance of the char settling procedure is discussed and criteria of what is considered good practice are outlined. The methods tested at St. Lawrence Sugar Refineries Ltd., Montreal, are mentioned and a description given of a satisfactory procedure and equipment developed. It is a modification of the conventional wet settling technique and includes a small hopper from which char falls at 45° and is spread into a fan-shaped curtain by a small deflector plate. To the front of the hopper is attached a liquor box with a weir having four horizontal marker wires corresponding to liquor-char ratios appropriate to the various stages of settling. The procedure is described and resulting flow rates, sweetening-off volumes and times, etc. are recorded.

* * *

The time factor in formation of sweet water. H. G. GERSTNER and G. P. MEADE. *Proc. 5th Tech. Session Bone Char*, 1957, 21–28.—Comparative data from washing of A and B service chars are recorded and the importance of "time in sweet water" (time to reduce from say 35°Bx to discard Brix) as a criterion of techniques is compared with volume of sweet water, although it is recognised that the two must be related.

* * *

Economic disposal of sweet water. E. J. CULP and M. DMITROVSKY. *Proc. 5th Tech. Session Bone Char*, 1957, 29–46.—The break-even point, at which the cost of processing sweet water is equal to the value of the sugar it yields, is characterized by an equation containing ten variables. Of these, however, all but two are constant over long periods of time and consequently the point is governed by a relationship between Brix and purity at the point of zero value of the sweet water. Assuming values for the other 8 parameters, a number of graphs are produced showing the values and costs of sweet water near the zero value point, its net value and financial loss incurred when turning the water to waste at other than the optimum point. Nomograms are presented for use by the operator in turning the char cistern to waste so that he can relate Brix and purity to select the optimum point. Out of 24 randomly selected cisterns only four were sweetened-off correctly without the use of the nomogram, the others being washed to too low a purity.

* * *

Selecting and using a solid adsorbent for decolorizing sugar liquors. E. D. GILLETTE. *Proc. 5th Tech. Session Bone Char*, 1957, 47–66.—The relative merits of bone char and granular carbon in the second stage of decolorization are discussed. Aspects discussed include colour removal, ash removal, pH control, volume required, sweet water, relative cost and combined overall utilization of facilities. It is shown that combinations of adsorbents were desirable for economic colour removal in the manufacture of liquid sugars. It is concluded that granular carbon showed some cost advantage over bone char in this limited application (second stage decolorization).

* * *

The role of aconitic acid in sugar refining. K. LÖWY. *Proc. 5th Tech. Session Bone Char*, 1957, 67–75.—Addition of small amounts of citric acid to melt before the pans has successfully inhibited scale formation by sequestration of the calcium content. The citric acid could be replaced by 2–5% of filtered raw liquor before char, and it was assumed that this contained a complexing agent; this was found to be aconitic acid. However, the presence of polyanions has been shown to affect colour removal by char, and the adverse effect of aconitate ion, particularly in the presence of monatomic cations e.g. Na and K, is demonstrated.

* * *

The Nichols Herreshoff char kiln at Canada & Dominion Sugar Co. Ltd. Redpath refinery, Montreal. W. A. R. ALLEN. *Proc. 5th Tech. Session Bone Char*. 1957, 83–98.—A comparative description is given of the Herreshoff kiln at Montreal, which differs from the kilns at Yonkers and Liverpool, and an account is given of operating experience since 1956. The kiln is considered a vast improvement on the old equipment.

* * *

Effects of controlled decarbonization on the performance of service "Synthad". F. W. SCHWER, W. V.

LOEBENSTEIN and E. P. BARRETT. *Proc. 5th Tech. Session Bone Char*, 1957, 145–162.—Analysis of the B-char at the Pennsylvania Divn. of National Sugar Refining Co. (mixed bone char and "Synthad") showed that the carbon content was 10·3 as compared with normal 7·3%. Column tests showed that decolorization could increase by reduction of the C content and this has been confirmed in practice following an increase of 25–50°C in kiln temperature which dropped the C content to 7·7%.

* * *

Some mechanisms of colour and ash removal by bone char. A. GEE. *Proc. 5th Tech. Session Bone Char*, 1957, 163–177.—The alternative mechanisms of colour and ash removal—adsorption, ion exchange and displacement—are discussed in connexion with the changes taking place in treated sugar liquor. Adsorption series are prepared for cations and anions and displacement effects studied. The characteristics of new char adsorption have been examined, and the practice of washing before use is confirmed.

* * *

Clarification and demineralization of Egyptian cane blackstrap molasses. A. M. GAD and A. S. EL-NOCKRASHY. *Egypt. J. Chem.*, 1958, **1**, 399–411; through *J. Sci. Food Agric. Abstracts*. 1959, **10**, ii–40.—Centrifuging removed all silicon present; ion exchange freed the molasses from almost all of its mineral salts, but also caused inversion, raising reducing sugars content from 10·15 to 25·05%; treatment with H_2SO_4 removed 98% of the Ca^{++} present; addition of $Al_2(SO_4)_3$ removed 71% of the K^+ as alum; treatment with tartaric acid removed 90% K^+ and 72% Ca^{++}; and treatment by a liming-double carbonatation-single sulphitation process removed 36·3% K^+ and 27·5% Ca^{++} and 55·3% of the aconitic acid present.

* * *

Cation exchange in plantation white sugar manufacture. W. CHEN. *Taiwan Sugar*, 1959, **6**, (6), 13–24.—Laboratory and factory trials were carried out on treatment of cane juice with cation exchange resins after second carbonatation, in order to reduce evaporator scaling, improve processing, etc. The laboratory column tests showed that a regeneration level of 10–20 lb of salt/cu.ft. of resin was to be recommended, giving an exchange capacity of 16–21 kilograins per cu.ft. and a salt efficiency of 0·6–0·9 lb salt per kilograin of hardness removed. Hardness leakage became excessive with lower than 10 lb salt/cu.ft. of resin. Variation in influent hardness concentration did not significantly affect exchange capacity but had a marked effect on leakage hardness. The presence of large amounts of monovalent ions, particularly K^+, in cane juice lowered the exchange capacity and increased hardness leakage considerably. The process gave almost complete exchange of Ca, but did not affect Fe, with Mg and K effects intermediate. The optimum regenerant brine concentration was 10–14%. The factory tests showed reductions of 68% and 50% in CaO content for two periods when, also, the evaporator efficiency was increased and no new scale formed, some old scale being removed. The treated juice was much clearer although its colour was not much affected. Syrup Brix was higher, colour lower by 26% and viscosity about 7% lower. Molasses viscosity was reduced by 29·5% and pan work was easier, and, although the ash in sugar was the same, its keeping quality was improved because of the lower moisture content. There was no noticeable increase in recovery.

* * *

Vitaminization of sugar with ascorbic acid. V. A. CHEREDNIK and E. A. GUSEV. *Sakhar. Prom.*, 1959, (8), 12–13.—Trial production of pressed sugar with ascorbic acid crystals (vitamin C) was carried out at Krasnopresnensk refinery in 1958. The acid crystals are mixed with refinery seed (200 and 400 g to 100 kg) and the pressed sugar dried for 8 hr at 50–85°C in a drum dryer. The sugar was packed in cardboard boxes covered by polyethylene film and stored for 1 year. Despite great fluctuations in temperature and R.H. the ascorbic acid content did not fall by more than 5%. The reducing substances increased from 0 to 0·09%, while the sugar moisture content hardly changed. The colour increased from 0·5 to 1·97°St. The sugar has a yellowish hue and a slightly acid taste, should contain at least 99·6% pure sucrose, 0·2% ascorbic acid and a maximum of 0·1% reducing substances, and have a maximum moisture content of 0·2%. The need for a mixer design to proportion the vitamin and sugar accurately is mentioned.

* * *

BMA continuous centrifugal with a conical basket. V. Z. SHAPRAN. *Sakhar. Prom.*, 1959, (8), 38–40.—The centrifugal comprises a bottom-shaft driven conical basket with the power unit located at the side of the outer casing. The massecuite is fed to the bottom of the basket, at 135 mm from the axis, and is accelerated to the peripheral speed of the basket when it starts to climb to the upper edge. The sugar is then "dry spun" after washing with steam and water (50 litres of water/hr). At the upper edge the dried sugar is thrown off via a sugar compartment to a conveyor, and the run-offs pass via another compartment and through a pipeline out of the centrifugal casing, sampling cocks for periodic checks on run-off density being provided. The capacity of the centrifugal is given as 7–8 tons/hr sugar, and the electric motor is of 26 kW, operating at 2960 r.p.m.

* * *

Study and calculation of the mill settings. U. VILLAR LORENZO. *Bol. Ofic. A.T.A.C.*, 1959, **18**, 175–181; 335–340; 407–410; 469–480; 539–549.—The meaning of the term "mill settings" is defined, and the effect of a number of factors—quantity of cane, fibre % cane, bagasse composition, angular and linear velocities of the mill rolls, material of construction of the rollers and turnplate, juice drainage, cane feeding devices, maceration, etc.—is discussed. Calculations are presented for determining by three methods the proper feed and discharge openings in a tandem.

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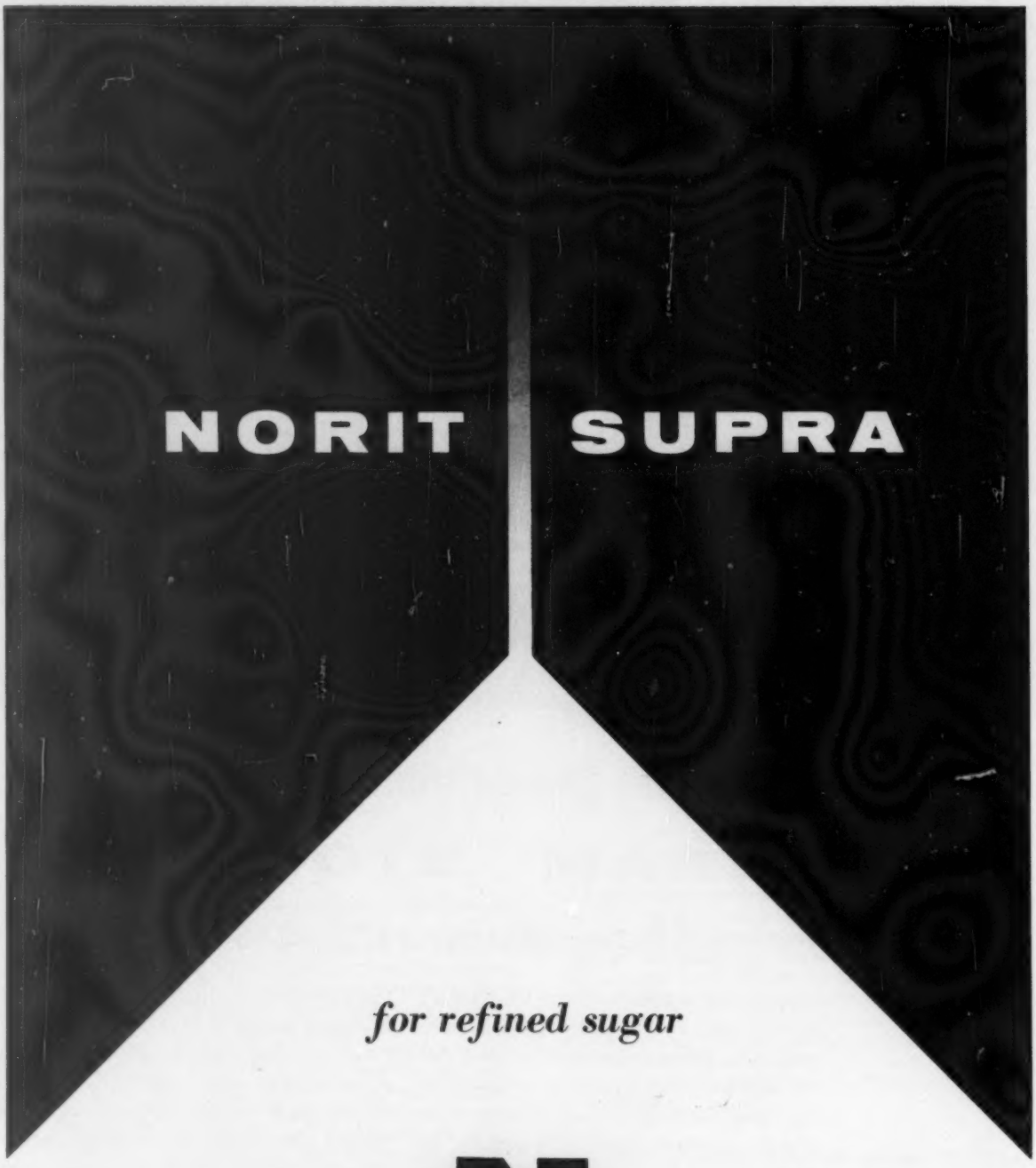

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BEET FACTORY NOTES

Review of investigations into sugar beet storage from the biological viewpoint. M. DRACHOVSKÁ. *Listy Cukr.*, 1959, **75**, 172–177.—A recent study of material from the period 1951–1957 has demonstrated the extent of sugar losses in roadside clamps and factory piles. The losses in "mechanized" store places were generally greater than in the flumes and were higher at the start of the campaign, provided that the beets were not stored too long. Recommendations include: storage in prisms 3–5 m high, with maintenance of a temperature of +2 to +4°C in the clamps, and covering with brushwood and grass; where necessary to spray with milk-of-lime (2–6°Bé with 0·1% chloride of lime on 20°Bé milk-of-lime) or V–K chalk.

* * *

The effect of battery diffuser disinfection on the extent of undetermined losses. P. PAVLAS, E. KVAPIL, J. LUSKAC, A. TOMECEK, J. JEBAVY and K. LISKAK. *Listy Cukr.*, 1959, **75**, 180–188.—At 3 Czechoslovakian factories the Robert battery diffusers were disinfected with formalin. Each cell was treated once every 8 hr with 250 ml of 40% formalin diluted to 5 litres. In two factories 4 litres of 40% formalin were added every 8 hr to the condensate being fed to the diffuser from the pressure tanks. The pH and acid formation of juice samples were determined every 8 hr before and 4 hr after heating to 40°C. Details are given for each factory, with graphs of pH, acid formation, diffusion losses, and diffusion cycle, with and without disinfection. Chloride of lime was also used in beet washing and had an inhibiting effect on infection. With addition of formalin to the diffusion water the reduction in losses was less than with direct addition to the cells. This is probably due to the great dilution of the formalin in the pressure tank and to the exhaustion of the disinfectant in the tail cells. Acid production should not increase by more than 50% in 4 hr in the case of satisfactory disinfection, and an automatic device for formalin feed every cycle is recommended. Alternate formalin and $CaOCl_2$ feeding is recommended, especially with very dirty and deteriorated beet.

* * *

The Quentin process at Franken sugar factory. H. NEUMANN. *Zucker*, 1959, **12**, 374–382.—The Quentin ion-exchange process plant for purification of B-molasses[1] at Franken is described and performance data are given. About 60–70% of the factory's B-molasses is treated. The plant handles batches of 54 cu.m. of molasses and comprises : three 2 m dia. vessels, 2/3 full of resin; three 10–20 cu.m. tanks, one each for condensate, sweetening-off water, and treated molasses; a 50 cu.m. tank for preparation of the magnesium chloride solution; a 10 cu.m. dilution vessel for the $MgCl_2$; and 5 pumps and receiving tanks, etc. All valves are programme-controlled. A hand refractometer is used to ensure that the molasses Brix does not exceed 70°, because the viscosity would increase sharply and retard flow. During the first campaign, about 30 runs were analysed, and details are given of water consumption per cycle, and of the molasses K, Na and Mg content before and after treatment. The Na and K in the molasses were reduced by 16·8% and 23·5% respectively with 65% molasses treated. With treatment of an amount of molasses greater than 54 cu.m.(e.g. 66 and 84 cu.m.) the proportion of ions exchanged was decreased. Untreated molasses, analysed chromatographically, contained 2·2–3·1% raffinose, with a mean purity of 55·6. Treated molasses contained 0·5% raffinose, and yielded 0·33% more sucrose (on beet). Although the treated molasses was more viscous than untreated molasses of the same Brix, spinning of the massecuite was extremely good, and the after-product sugar was very homogeneous and dry.

* * *

The punched-card system and its practical application in the sugar industry. W. LEIBIG. *Zeitsch. Zuckerind.*, 1959, **84**, 399–404.—The punched-card system at Franken sugar factory is described, with details of individual machines and of types of cards. The system is used at present for beet and molasses payment, but application to payment of wages, invoicing, and sugar sales statistics is considered for the future.

* * *

On some question of sugar purification. F. TESCHNER and H. AHLERS. *Zuckererzeugung*, 1959, **3**, 217–220.—As a preliminary report results of laboratory tests on the effect of dextran on the treatment of juice from deteriorated beet are discussed. A sucrose-dextran solution, to which was added calcium chloride, was saturated with sodium carbonate and the filtration coefficients (F_E) were determined at various pH values. A proposed juice purification scheme is described, for normal and deteriorated beets, in which 1st and 2nd carbonatation muds are returned to separate zones of the pre-liming tank. With very deteriorated beet no milk-of-lime is added, and the raw juice treated instead with returned first carbonatation juice of pH 9·5.

* * *

Sugar and sodium content of the beet root as a criterion of varietal evaluation and the ripening rate of sugar beet. H. LÜDECKE and M. NITZSCHE. *Zucker*, 1959, **12**, 392–401.—Experiments have shown that flame photometric determination of the sodium in press juice gives a clear evaluation of the beet quality, whereas this is not shown by yield and polarization. It will also provide a simple check on the state of beet ripeness.

* * *

The operation of lime kilns. S. WINKLER. *Zucker*, 1959, **12**, 411–415.—The maintenance of the correct limestone level in a kiln is discussed and the choice of materials for kiln walls mentioned. A special

[1] *I.S.J.*, 1958, **60**, 174.

corundum stone investigated at Twülpstedt sugar factory has given excellent results in tests, sample refractories suffering no wear after 2 years in the burning zone. Only 20–25 mm was worn away from the whole wall after 3 years.

* * *

Nomogram for determination of heat transmission coefficients in evaporators. T. BALOH. *Zucker*, 1959, **12**, 408–410.—A nomogram is presented, based on the equation

$$k = \frac{Wr}{F.\,\Delta t_w}$$

where k = coefficient of heat transmission in kcal/sq.m./min/°C, F = heating surface in sq. m., Δt_w = effective temperature difference in evaporator in °C, W = evaporation rate in kg/min, and r = latent heat of evaporation (= 530 kcal/kg on average). A calculation is presented as example.

* * *

On R. Gottschalk's article "A new method of sweetening-off defecation muds". E. WERNER. *Zucker*, 1959, **12**, 410–411.—Certain points in the article by R. GOTTSCHALK are disputed[1].

* * *

Trend to bulk sugar spurs Great Western's expansion. ANON. *Link-Belt News*, 1959, **26**, (4), 1, 6–7.—Bulk handling developments in the Great Western Sugar Co. include four new bulk storage silos for white sugar at Loveland factory[2] and bulk white and liquid sugar terminals at Milwaukee and Chicago. The silos are of 35 ft dia. and 200 ft high (160 ft storage height) and each holds 3750 tons of sugar. A screw conveyor and bucket elevator carry sugar to the top of the silos at about 60 tons/hr, delivering each day to a different bin to allow cooling. Sugar is reclaimed through 21 chutes in each bin, delivering to a screw conveyor system feeding an elevator to a 70-ton scale hopper or to the loading elevator for re-circulation. The bulk sugar transfer station at Milwaukee receives 60 ton rail car loads of sugar which are dumped in a pit and elevated to a 75 ton storage tank. From this it is deposited into road tank trailers under gravity. At the bulk station in Brookfield, servicing Chicago, the sugar is dumped similarly and carried to four bins. These discharge into road tankers, while the fourth feeds a dissolving bin for production of liquid sugar.

* * *

Operation of the D.d.S. continuous diffusion system. N. ARNTH-JENSEN and H. DOHN. *Seker*, 1959, **8**, (32), 18–22.—The principles, development and performance data for D.d.S. beet diffusers in Denmark are described.

* * *

Experiments made with activated carbon and kieselguhr. P. GÜRAY and M. SÜTMEN. *Seker*, 1959, **8**, (32), 12–14.—Three grades of claircе were treated with (1) active carbon alone (2) active carbon plus kieselguhr, and (3) kieselguhr alone. With claircе of 99·52 purity, the purity was raised to 99·68, 99·84 and 99·84, respectively, while for claircе of 99·24 purity, the corresponding figures were 99·38, 99·53, and 99·38. Treatment of a 96·66 purity claircе gave syrups of 97·46, 97·79 and 97·47 purity, respectively.

* * *

Continuous sugar centrifugals. T. KOWALCZYK. *Gaz. Cukr.*, 1959, **61**, 205–209.—A review is given with diagrams of continuous centrifugal designs, including the B.M.A., Escher Wyss push-type, the Hein, Lehmann "Hydromat", the Western States continuous[3], and the "Godard-Sticker"[4] and Krauss-Maffei "spiral" centrifugals.

* * *

Steam requirement and consumption of turbines. W. BARTOSZEK. *Gaz. Cukr.*, 1959, **61**, 210–211.—The steam balance of turbines is discussed and a sample calculation is presented.

* * *

Werkspoor crystallizers at Przeworsk sugar factory. B. ZELBA and C. ROPA. *Gaz. Cukr.*, 1959, **61**, 211–214. —Oswiannikow crystallizers were replaced in 1958 by a battery of six 210-hectolitre Werkspoor crystallizers. Details are given of their construction and of the cooling water feed system. Performance data are tabulated and show a molasses mean purity for the campaign of 62·2 in 1957 falling to 61·11 in 1958, as well as a molasses yield drop from 3·59 to 3·25% on beet.

* * *

Method of cleaning a 2nd carbonatation juice pipeline. S. GAWRYCH. *Gaz. Cukr.*, 1959, **61**, 217–219.—Scale in 2nd carbonatation juice pipes at Lublin sugar factory is removed by 2½ days' treatment with Na_3PO_4 in hot raw juice (0·125% on juice) and CaO (0·063% on juice). The economics are discussed.

* * *

A two-stage diffusion battery[5]. L. I. SHAPIRO. *Sakhar. Prom.*, 1959, (8), 9–10.—Splitting a battery diffuser into two halves, connected by two idle diffusers as juice tanks, is recommended as one means of increasing throughput. A reduction in the diffusion cycle e.g. from that of a 14-cell battery to that of a 6-cell battery, can be balanced by raising the mean temperature to 80°C and working thinner cossettes. Sugar extraction and losses would be those of a 12-cell battery, and the throughput can be increased by at least 15%. Furthermore, increasing the length of the cylindrical part of each cell by 300–350 mm and removing the chains in the upper half of the cell will allow a 12–15% increase in the effective volume, giving a total throughput increase of 25–30%. The draught can be reduced from 120% to 105%. Conversion to a 5-valve battery is necessary.

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[1] *Zucker*, 1959, **12**, 301; *I.S.J.*, 1959, **61**, 374.
[2] See *I.S.J.*, 1959, **61**, 361, and frontispiece for 1959.
[3] See *I.S.J.*, 1957, **59**, 136.
[4] See *I.S.J.*, 1954, **56**, 108.
[5] *See also I.S.J.*, 1959, **61**, 311.

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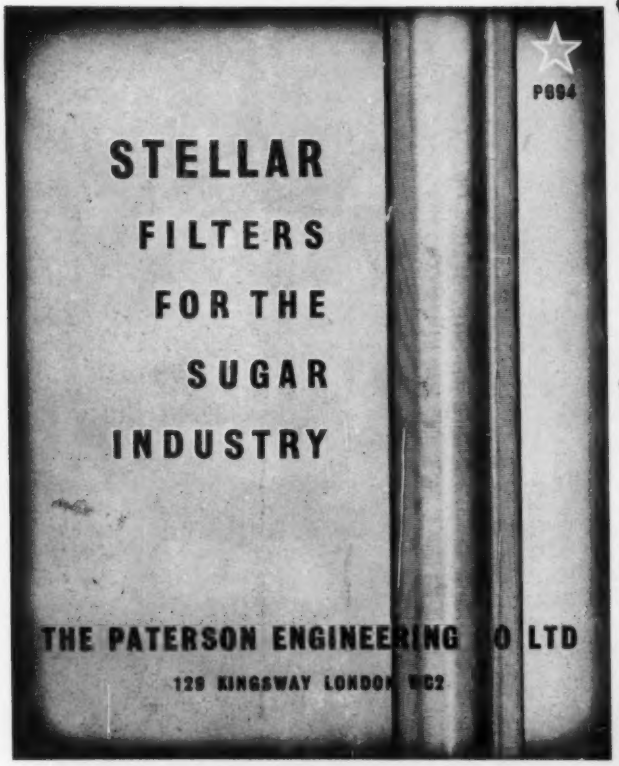

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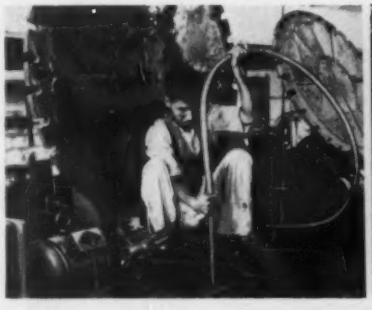

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Latest techniques for receiving and storing beet. N. D. GRISHCHENKO. *Sakhar. Prom.*, 1959, (8), 10–11.—The RUSK-54 unloading-piling combine can handle 60 tons of beet per hr. The handling costs are reduced by 80% compared with manual handling and the beets are cleaner and less prone to damage. Beet stored in 4 m clamps for 60 days are better than those handled by rake pilers. Covering clamps (up to 1st January) with reed mats measuring 2·6 × 1·0 × 0·08 m and weighing 22–25 kg has proved successful, the extent of pollution being much reduced on earth covering.

* * *

New work on automation of defeco-saturation. P. L. BOZHKO. *Sakhar. Prom.*, 1959, (8), 30–38.—Full details are given of the automatic carbonatation scheme at the Stalin sugar factory, including automatic lime metering to defecation, pH control of 1st and 2nd carbonatation juices, and saturation gas pressure control. A compact electric drive for existing valves is described, which allows easy conversion to manual control by handwheel in emergency. No spillage has been experienced in juice flow from diffusion to evaporation.

* * *

Examination of the performance of Petoháza J-diffusion during the 1958–59 campaign. K. HABERÉNYI, M. TEGZE, O. VAJDA and K. VUKOV. *Cukoripar*, 1959, **12,** 65–68; through *S.I.A.*, 1959, **21,** Abs. 536.—In accordance with expectation, no hydrodynamic difficulties were experienced with either thin cossettes or deteriorated beets, and the diffuser showed high mechanical reliability and no corrosion. The diffusion was carried out with 125% draw-off and full press-water return; extraction time was 56·2 min, and sugar losses 0·24% on beet. Infection by micro-organisms was much less (at least a hundredth) than that in a disinfected Robert battery operated at the same time, and decreased during diffusion. Sugar loss owing to infection was <0·01%. The thin juice purity was better than that with battery work.

* * *

Pump and installation for continuous dosing of sodium hypochlorite. O. VAJDA and T. ZÁGON. *Cukoripar*, 1959, **12,** 69–71; through *S.I.A.*, 1959, **21,** Abs. 537. An ebonite pump with a bronze piston and closure valves formed by rubber balls against bronze seatings is described for use in the continuous disinfection of a diffusion battery. The pipeline for the supply was unsatisfactory in ebonite or PVC, so an "oxygen" tube of rubber with double-cotton internal lamination, 8 mm inner diameter, was used.

* * *

Experiments for reduction of the viscosity of mid-products and increase of the sugar yield. Z. I. TÓTH. *Cukoripar*, 1959, **12,** 101–103; through *S.I.A.*, 1959, **21,** Abs. 543.—Addition of 25 kg of $CaCl_2$, in 5 kg portions each dissolved in 10–15 litres of water, to a 500 quintal pan during boiling reduced the viscosity to 70% of that in a control pan, and the time of boiling was reduced to 97·3% of that in the control pan. The syrup purity was, most remarkably, reduced to 95% of the control value, and centrifuging time was reduced by 9·8%. Results are tabulated to show the definite nature of the improvements.

* * *

Experience in juice purification at Selyp (beet) sugar factory. E. VALKOVSKY. *Cukoripar*, 1959, **22,** 162–165; through *S.I.A.*, 1959, **21,** Abs. 539.—Details are given of improvements in recent years. Experiments are reported for the development of methods which will enable rotary drum filters to be used.

* * *

Losses of molasses in storage. O. A. BAKYSHINSKAYA. *Khlebopekar i Konditer. Prom.*, 1959, **3,** (2), 13–16; through *S.I.A.*, 1959, **21,** Abs. 548.—Laboratory studies on sugar losses during storage are reported. Micro-organisms are not active in molasses of 72°–82°Bx. Spore-forming bacteria cause appreciable losses even in a slightly diluted (68°–69°Bx) molasses, amounting to 1·3% per month of storage at a content of 50,000 bacteria/g. Special experiments have shown that yeasts become really active at about 40°Bx; this can occur at points of localized dilution, and subsequently the yeasts may spread in the molasses and cause substantial losses of up to 2·5% per month on molasses (of 46% purity).

* * *

Experiments with a drum filter in the Mezöhegyes sugar factory. F. EMÖDI and O. TISZÁVARY. *Cukoripar*, 1959, **12,** 92–94; through *S.I.A.*, 1959, **21,** Abs. 570.—The per cent. retention of sugar in muds (taking the initial concentration as 100) has been measured as a function of the length of the drum circumference used for washing, = area of sweetening-off. Four pipes delivering water for washing provided too much water at the beginning; narrower washing jets were better. With one jet replaced by a triple divided jet the results were worse at the beginning and better at the end. Finer subdivision of washing jets is therefore advocated.

* * *

Operation, efficiency and calculation of clarifiers of various designs. B. BRUKNER. *Zucker*, 1959, **12,** 430–431.—Calculation of the effective area of a clarifier and clarifier efficiency, based on the sedimentation rate of the mud particles, is discussed. The notes given refer to various types of clarifiers, both with and without mechanical scrapers.

* * *

Glutamine of sugar beet and its influence on the value of "noxious nitrogen". J. VELLARD. *Compt. Rend. Acad. Agric. Fr.*, 1958, **44,** 898–901; through *J. Sci. Food Agric. Abs.*, 1959, **10,** ii–90.—Weekly analyses of growing sugar beets show the following changes: up to the end of the 23rd week, a rapid increase in the sugar content; from the 23rd to the 26th week, a constant sucrose content and a decrease in the organic non-sugar fraction, accompanied by an increase in

its glutamine content; from the 26th to the 28th week, a slight increase in the sucrose, and a relatively large increase in the organic non-sugar fraction, accompanied by a marked decrease in its glutamine content. A purer juice with a higher (commercially valuable) glutamine content could be obtained without loss of sucrose by harvesting at the end of the 26th week instead of at the end of the 28th week.

* * *

Reduction of the influence of the preheating section in multiple effect vertical tube evaporators for solutions. H. TONN. *Zeitsch. Zuckerind.*, 1959, **84,** 457–458.—As a result of the hydrostatic head in a vertical tube evaporator, the liquor pressure below the calandria is higher than that of the vapour above, so that part of the tube must be used to heat the juice to a temperature greater than that of the vapour. Reduction of the preheating section of the tube, the length of which increases with tube length and with decrease in the vapour pressure, is discussed as well as the problems presented by the heat flow in evaporators with central downtakes. The pre-heating section can be eliminated from the first effect by installing a preheater and slightly increasing the pumping pressure to a level adequate to raise the temperature of the liquor.

* * *

Five years of the Chile sugar industry. L. HUTZL. *Zeitsch. Zuckerind.*, 1959, **84,** 458–462.—The Chilean sugar industry is reviewed, with notes on its history, from its inception (with the first, but unsuccessful, factory put into operation in 1858) to the preliminary work on the third of the BMA beet factories at Linares in 1958. Details and plans are given of Los Angeles and Llanquihue[1] factories, the other BMA factories, which commenced beet processing in 1954 and 1958 respectively.

* * *

Automation in sugar manufacture technology. L. RYCHETSKY. *Listy Cukr.*, 1959, **75,** 204–208.—Equipment of Czechoslovakian manufacture for use in automation schemes is described with illustrations. It includes an electric compensating regulator, pneumatic ratio transmitter, accelerometer, pneumatic relays, etc.

* * *

Nomogram for operative control and supervision of low-product massecuite crystallization (Silin-Claassen). A. SEPITKA. *Listy Cukr.*, 1959, **75,** 209–211.—A nomogram is presented for calculation of the amount of dilution water needed for a low-product massecuite, based on the non-sugars : water ratio in the water and on the two criteria not normally considered: the Silin "standard" purity of molasses and the temperature during centrifugalling. The nomogram enables rapid calculation to be made of the "standard" molasses purity on the basis of analysis of the saturated run-off from the centrifugal and of the non-sugars : water ratio (for supersaturation) for the corresponding centrifugalling temperature. It is assumed that the non-sugars composition and the "standard" molasses purity do not change in 1–2 days. The non-sugars : water ratio is given by

$$f\left(\frac{370 + t - 0{\cdot}01\ tq_n - 3{\cdot}7q_n}{130 - t}\right)$$

where f = saturation coefficient, t = temperature corresponding to saturation, and q_n = molasses "standard" purity.

* * *

Decolorizing sugar juices by means of decolorizing resins. II. Column decolorizing tests. S. FUMASONI, E. MARIANI and G. MAURA. *Ind. Sacc. Ital.*, 1959, **52,** 349-357.—The effect of contact time on decolorization of sugar juices was studied by means of column tests using "Asmit 259", "Asmit 224" and IRA 4015" resins at a controlled temperature of 80°C, through which were passed thick juices, a 2nd product remelt and a refinery syrup. The colour before and after was measured by extinction at 560 mμ as a representative wavelength for the range concerned (440–660 mμ). It was found that decolorization decreased with decreased time of contact and the data recorded are shown in the form of graphs. It was shown, however, that for flow rates of 3 vols/vol of resin/hr, the decolorization was approximately the same as reached at equilibrium between the juice and the same quantity of resin in a batch decolorization. Examination of pH, alkalinity, and ash content of the treated juices showed that they had not been affected by the resins which had only decolorizing and no ion exchange capacity.

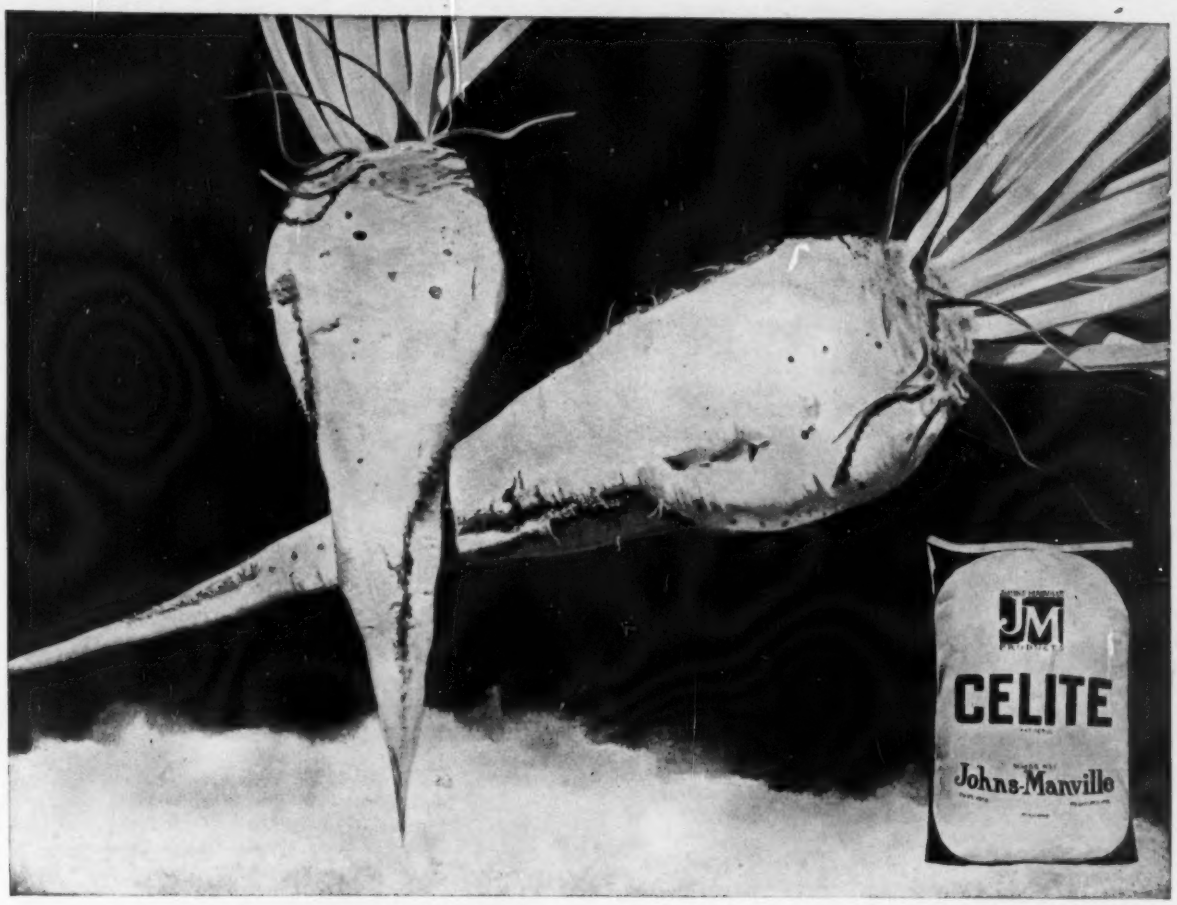
* * *

A sucrose-inactive lattice hetero-ferment from raw juice. C. ZAMBONELLI. *Ind. Sacc. Ital.*, 1959, **52,** 363–366.—A bacterium has been isolated from diffusion juice in which it sometimes represents the bulk of the microflora present. It is very similar to *Lactobacillus brevis* except for its strong, though not completely stable, thermophilic properties. The bacterium, while not affecting sucrose, ferments fructose more rapidly than glucose and it may therefore cause errors in polarimetric determination of the sucrose.

* * *

Control-measuring instruments (immersion pH meters). Z. NITSCHKE. *Gaz. Cukr.*, 1959, **61,** 239–242.—The GET pH meter manufactured by the Austrian firm Seibold is compared with the Polish "Piezoelektronik 4 a". The former has given good results to within an accuracy of ±0·1 units at various factories in progressive liming pH control, and in 1st and 2nd saturation control, while the latter instrument has only been laboratory-tested. The Polish meter is considered to have a better circuit design than the other, but its temperature range of 10–40°C is considered too restricted and should be extended to 80–90°C.

[1] *See also I.S.J.*, 1959, **61,** 276.



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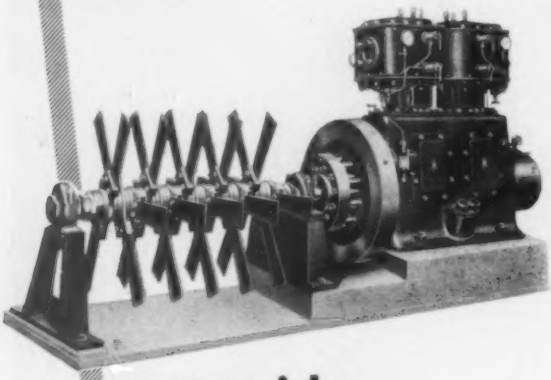

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New Books and Bulletins

Japan Sugar Yearbook 1958. 134 pp.; 8¼ × 11¾ in. (Daiichi Bussan Kaisha Ltd., P.O. Box 882, Tokyo Central, Japan.) 1959.

This is the first edition of a yearbook which is a most welcome source of statistical and other information concerning the Japanese beet sugar and refining industries. It includes a map of Japan showing the location of the factories and refineries, with enlarged maps of the Osaka and Tokyo areas. The text is divided into two parts—the larger entitled "Sugar statistics" and the smaller "Sugar Industry in Japan". In the former are presented tables of imports by sources from 1920, by type yearly from 1946 to 1952 and then monthly from 1952 to 1956. Exports by destinations from 1929 to 1956, and by type from 1946 to 1954 yearly are given as well as monthly data for 1954–1956. A third series of tables give sugar production, cane and beet areas, crop yields per hectare for Japan during 1920–57, with production data for Taiwan, the Ryukyus and the Marianas during 1920–46. Other production figures are tabulated for Amami-Oshima and Hokkaido 1920–57, South Sakhalin 1936–46 and Korea 1920–32. Consumption data are given for Japan, Taiwan, Korea and the Marianas, the first from 1920 to 1956, while this is broken down into the various sugar types for 1952–56. A map shows the contrast between pre- and post-war Japanese territories and sugar supplies. Sections are devoted to futures, actual, wholesale and retail refined sugar prices, while production figures for 1920–56 are recorded, by refineries from 1952 to 1956. Sugar taxes are listed, while a list of pre-war (1939) sugar factories is given with their capacities. Imports by quotas are tabulated and a survey made of sugar refineries and their capacities over the period 1949–56.

The Japanese sugar industry is organised in five associations, four of refineries and manufacturers, and the other of importers. Addresses and members are listed and details also given of the Tokyo, Osaka and Kanmon Products exchanges. Details of some of the individual companies are presented, with a summary of contract terms for the exchanges, and facilities of the major Japanese ports.

* * *

Sugar Year Book 1958. v + 198 pp.; 3½ × 5¼ in. (International Sugar Council, 28 Haymarket London, S.W.1.) 1959. Price: 10s. 0d.

The latest edition of the former "Pocket" Sugar Year Book retains its convenient size but is considerably thicker than in former years. This reflects the greater amount of information it contains, which is most valuable in spite of the delay in publication caused by the printing strike last year. The main section of 163 pages, as before, comprises tables of sugar production, imports and/or exports, consumption, stocks and such data, for 86 countries, from Aden to Yugoslavia, expressed in metric tons and covering, in many cases, the calendar years 1952 to 1958.

A series of tables gives world sugar production, consumption, consumption per caput, net exports and imports, stocks and free market requirements and supplies. London and New York sugar prices and the Commonwealth "agreed prices" for the years since 1950 are tabulated, while refined sugar prices in a number of selected countries are also listed—with their equivalents in U.S. and U.K. currency. A table of equivalent weights and measures is included, and a short article on the British Commonwealth Sugar Agreement. The 1959 position as regards Commonwealth quotas is indicated, and the U.S. Sugar Quotas for 1956–58 (final) and 1959 (basic) are recorded in another table. A final table lists the basic quota tonnages of the exporting countries participating in the International Sugar Agreements of 1952 and the Protocol of Amendment of 1956, together with the final quotas for 1958.

* * *

Report of the Proceedings of the Twelfth Session of the International Commission for Uniform Methods of Sugar Analysis. 130 pp.; 8¾ × 10¾ in. (ICUMSA, Tate & Lyle Research Laboratories, Keston, Kent). 1959. Price: 25s. 0d.

The official *Proceedings* of the 1958 Session of ICUMSA in Washington, under the presidency of H. C. S. DE WHALLEY, records the business of the meeting and the Agenda reports and discussion on all but two of the Subjects. In the introductory business section appears the list of delegates and observers present; addresses by Drs. G. P. MEADE, A. V. ASTIN and E. WICHERS and by the President; Committees and the election of officers; the treasurer's report and a note of the date and place of the next Session which is to be held in Berlin in 1962. The visits and social functions attended by delegates and their ladies are recorded.

The texts of the Referees' reports and the discussions they provoked are given in full together with the recommendations which were adopted. (These have been published prior to the *Proceedings*[1].) The volume contains a photograph and obituary notice of the late Life Honorary President, F. J. BATES, and group photographs of all delegates and their ladies, and the U.S. and British Commonwealth delegates and ladies. A most useful innovation is the section of author and subject indexes which distinguish between mentions in the reports, discussions and references.

The *Proceedings* are well printed and bound in the same style as those of the previous Session and contain only a few typographical errors.

[1] *I.S.J.*, 1958, **60**, 263.

Methods of sucrose determination in sugar beet. H. HIRSCHMÜLLER and H. HÖRNING. *Zeitsch. Zuckerind.*, 1959, **84**, 389–399.—The various methods of determining sugar in beet are reviewed with 211 references to the literature. As the results of any method described are dependent on a number of factors, with wide variations in the error, it is inexpedient to give a result to within an accuracy greater than 0·1% sucrose. Even the first place of decimal is not foolproof, even with the most accurate method. Thus a low or high loss figure for any factory is not a sure guide to its efficiency. A table is given of 17 well-known methods, with the possible sources of error for each method. On the basis of the number of sources of error, the most accurate method is the Stanek-Pavlas cold water digestion, while the Clerget inversion polarization, the Rapp-Degener alcoholic digestion, the Krüger-Primavesi cold digestion, and the press juice methods are the most inaccurate. The need for a specific method of sugar determination is emphasized.

* * *

Method for determination of the total amino acids and glutamic acid (aspartic acid) in sugar factory juices. V. PREY, L. MAIER and O. SZABOLCS. *Zeitsch. Zuckerind.*, 1959, **84**, 408–410.—An ion exchange method of determining the total amino acids, glutamic and aspartic acid in thin juice is described. The total amino acids are adsorbed on a strongly acid "Amberlite IR 120" ion exchange resin on the H cycle and are separated from sugar and non-N acids by washing with water. After elution with 2·5% ammonia, the eluate containing amino acid NH_4 salts is boiled to evaporate the excess ammonia and the free amino acids are obtained by passing through a weakly acid "Amberlite IRC 50" cation exchanger. After decolorizing with active carbon the amino acids are treated with formaldehyde and titrated with N/10 NaOH, with bromthymol blue as indicator. The titre of the first colour change (green to yellow) corresponds to the glutamic acid plus aspartic acid, while the titre to the second colour change (yellow to blue) corresponds to the total amino acid content.

* * *

Investigations on the viscosity of solutions of sucrose and of intermediate products of sugar manufacture. M. HORAWSKI. *Zeszty Naukowe Wyszej Szoly Rolniczej we Woclawiu*, 1958, (12), 44 pp; through *S.I.A.*, 1959, **21**, Abs. 490.—The presence of non-sugars in sucrose solutions increased the viscosity. Different cations (combined in salts with the same anion) increased the viscosity as the atomic number increased in the order $K^+ < Na^+ < Li^+$ and $Sr^{++} < Ca^{++} < Mg^{++}$. Different anions (combined in salts with the same cation) increased the viscosity, the effect increasing with anions in the series: $Cl^- < NO_3^- < CH_3.CHOH_3.COO^- < CH_3.COO^- < CO_3^{--} < OH^-$. The viscosities of well-exhausted molasses at saturation point were very high. Massecuite viscosity depended upon the size of crystal as well as upon the crystal content. Medium-fine crystal massecuites were the least viscous. Results are tabulated.

* * *

Improving the decolorization of molasses solution before polarization. T. P. KHVALOVSKII. *Sakhar. Prom.*, 1959, (7), 21–22.—Decolorizing a ½-normal molasses weight (1) with a large excess of Herles reagent (double dose 20 ml + 20 ml) in 5–6 portions at 2–3 min intervals, and (2) with a normal amount of Herles reagent (10 ml + 10 ml) with additional active carbon treatment, permitted differentiation between two purities within 0·1%. Additions of 1, 2, 4 and 8 g of active carbon were made to semi-normal weight of molasses (1) after treatment with Herles reagent, (2) to the filtrate after decolorizing with Herles reagent, and (3) before treatment with Herles reagent. Method (3) was unsuitable for polarization but the other two permitted purification determinations to within 0·1% accuracy. Used in conjunction with direct refractometry, these methods will permit determination of a difference of 0·2 units between two samples.

* * *

Abrasion hardness of bone char. F. G. CARPENTER. *Proc. 5th Tech. Session Bone Char*, 1957, 99–137.—The current methods of determining abrasion hardness were examined and found to be unsatisfactory as their results were conflicting. A method was developed, whereby 250–300 ml of char is placed in a cylindrical container of about 4⅛ in dia. and 5 in high with a lid through which passes snugly the shaft of a T-shaped mixer made of ½-in dia. steel rod, the arms having ½-in clearance from the container wall. The sample just covers the arm of the stirrer which is ½ in from the bottom of the container. It is driven at 855 ± 15 r.p.m. for 60 ± 1 min and the sieve analysis before and after are compared. Reproducibility is satisfactory and good correlation is obtained with refinery attrition provided that the latter is expressed as averages over a long time, preferably years. (This is because of the enormous amount of char in process and the very low rate of char abrasion.) The test is equivalent to 14 char house cycles for dust formation and to 35 cycles for size reduction. Possible mechanisms of char abrasion are considered. (*See also I.S.J.*, 1959, **61**, 182.)

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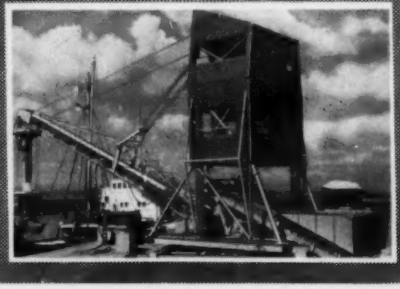

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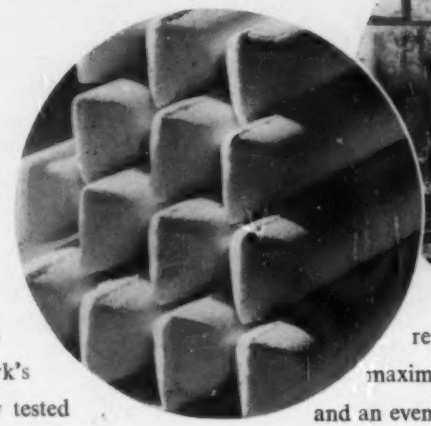

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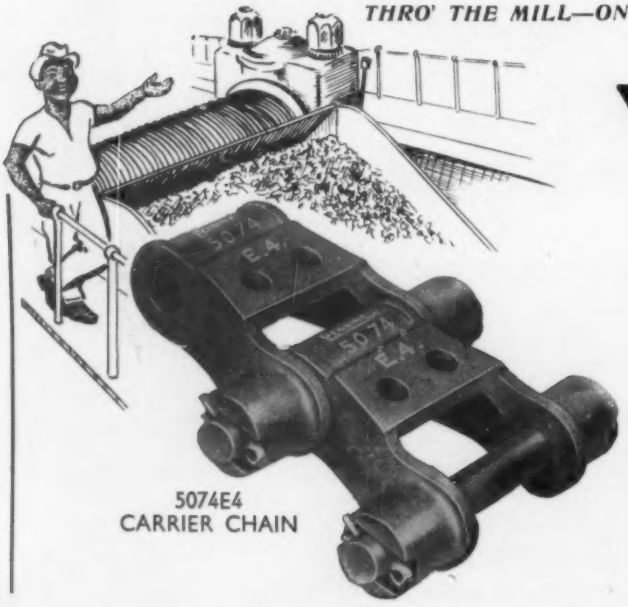

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UNITED KINGDOM

Transportation and/or utilization of molasses. F. GROSSMAN, of Salisbury, Southern Rhodesia. **821,762.** 12th November 1956; 14th October 1959. Molasses may conveniently be transported after absorption by mixing with an absorbent material such as ground maize or other edible cereal in the form of a meal or flour. The mass so formed may have a consistency ranging from powdery or friable to semi-plastic, and may be used as an animal fodder or the molasses recovered by warming over filters of the mass. The mass may also be subjected to candification by heating.

* * *

Beet lifter and topper. S. A. ANDERSEN of Stenstrup, Denmark. **822,996.** 15th August 1957; 4th November 1959.

* * *

Purification and clarification of aqueous liquids (sugar solutions). PETER SPENCE & SONS LTD., of Widnes, Lancs. **823,082.** 2nd July 1957; 4th November 1959. —Clarification is effected by mixing the sugar solution with a basic chloride of a trivalent metal (aluminium) in aqueous solution, the proportion of hydroxyl to total anions in the chloride being at least 15% (60–80%). The treatment may be used in conjunction with a reagent used to assist settlement.

* * *

Fondant and dry fondant sugar product and method of manufacture. CALIFORNIA & HAWAIIAN SUGAR REFINING CORP., of San Francisco, Calif., U.S.A. **823,399.** 5th June 1956; 11th November 1959.—A supersaturated solution containing 80% of sucrose and 20% of dextrose and levulose is combined with 30–70% of finely disintegrated sucrose particles, including crystals and crystal fragments, generally not exceeding 40 microns in diameter. The process is carried out at 260°–300°F, whereby particles of recrystallized sucrose are formed and are bound to the fractured crystals by links of dextrose and levulose. The agglomerates are dried and finally comminuted to a desired size.

* * *

Fermentation process for the production of glycerol. COMMERCIAL SOLVENTS (GREAT BRITAIN) LTD., of Bromborough Port, Cheshire. **823,740.** 8th January 1958; 18th November 1959.—A heat-sterilized fermentation medium containing beet molasses equivalent to 15–25% (20%) by weight of total sugars is treated with 0·037% w./v. of urea and 0·025% v./v. of invertase enzyme, these latter being in sterilized solution. The medium is inocculated with a glycerol-producing strain of *Saccharomyces rouxii* or *S. mellis* and fermented under submerged and aerated conditions at 30–37°C. Corn steep liquor and/or yeast extract may be present. The glycerol is recovered by steam distillation of the fermented medium.

* * *

Beet Harvester. G. B. W. FARM MACHINERY LTD., of Maxey, Northampton. **823,524.** 12th November 1957; 11th November 1959.

* * *

UNITED STATES

Soil conditioner. M. J. HILER, assr. COMMONWEALTH ENGINEERING CO. OF OHIO, of Dayton, Ohio, U.S.A. **2,901,864.** 22nd September 1955; 1st September 1959.—The conditioner is a thick turbid liquid containing 80–85% water and composed of native unhydrolysed dextran of M.W. at least one million (40–60 million) and an aqueous nutrient medium containing 20% sucrose, 2% corn steep liquor, 1% inorganic salts and the remainder water. The pH is adjusted to 6·5–7·5 and the medium sterilized and inoculated with a dextran-producing organism (*Leuconostoc*) followed by incubation at 20–30°C for 12–48 hr.

* * *

Producing glutamic acid. T. OGAWA, I. KOMORI, J. KAWAOKA, A. ISHIWATA and Y. FUJIYAMA, assrs. AJINOMOTO CO. INC., of Kawasaki, Japan. **2,905,710.** 21st March 1957; 22nd September 1959.—Beet molasses waste (e.g. concentrated Steffen's filtrate or vinasse) is acidified with mineral acid to pH less than 3 and extracted (in a multi-stage counter-current process) with a partially water-soluble mono-hydric aliphatic alcohol or mixture of alcohols (fusel oil), half- to completely-saturated with water. The alcoholic extract is separated and treated with water containing an alkali or alkaline earth hydroxide. The aqueous phase is separated, hydrolysed, re-extracted with the alcohol, and treated to crystallize the glutamic acid content.

* * *

Centrifugal. H. F. IRVING, assr. BAKER PERKINS INC., of Saginaw, Mich., U.S.A. **2,899,065.** 13th December 1954; 11th August 1959.—Cf. U.K.P. 808,376.[1]

[1] *I.S.J.*, 1959, **61**, 186.

FREE MARKET REQUIREMENTS FOR 1960

INTERNATIONAL SUGAR COUNCIL ESTIMATES[1]

The following estimate was made by the International Sugar Council on 26th November, as referred to on pages 1–2 of our January issue.

COUNTRY OR AREA—		*Total Requirements (in thousands of metric tons raw value)*
UNITED KINGDOM and BRITISH COMMONWEALTH—		
Parties to Commonwealth Sugar Agreement—		
United Kingdom (including Channel Islands) (total consumption)	2,850	
New Zealand (partial import requirements)	75	
Federation of Rhodesia and Nyasaland (partial import requirements)	45	
	——	2,970
Commonwealth Countries not parties to Commonwealth Sugar Agreement—		
Aden and Aden Protectorate	25	
Bahamas and Bermuda	5	
British East Africa (Kenya, Uganda, Tanganyika)	20	
British North Borneo	10	
British Somaliland, Zanzibar and Pemba	15	
Canada (total consumption including sugar equivalent of fancy molasses)	840	
Ceylon	170	
Cyprus, Gibraltar and Malta	25	
Gambia and Sierra Leone	15	
Ghana	40	
Hong Kong	70	
Federation of Malaya	185	
New Zealand and Western Samoa (balance of import requirements)	45	
Nigeria	65	
Pakistan	20	
Federation of Rhodesia and Nyasaland (balance of import requirements)	15	
Sarawak and Brunei	15	
Singapore	120	
	——	1,700
		4,670
	Estimated Supplies Available	
Canada (production)	160	
United Kingdom (production)	770	
British Dependent Territories (exports)		
Australia (exports)	2,615	
Union of Suth Africa (exports)		
	——	3,545
Estimated Requirements of the Free Market		1,125

FRANCE, FRENCH OVERSEAS DEPARTMENTS AND TERRITORIES

	(1) *Campaign* 1959/60. *Production*	*Consumption*
Metropolitan France	1,000	1,400
French Overseas Departments and Territories which do not import sugar—		
Martinique, Guadeloupe, Réunion, Madagascar	475	45
French Overseas Departments and Territories which import sugar—		
Africa, excluding Algeria	0	150
Algeria	0	250
Other territories	0	5
Difference of 375,000 metric tons imported towards stocks (150,000 metric tons in calendar year 1959 and 225,000 metric tons in calendar year 1960).	1,475	1,850

	(2) *Calendar year* 1960 (*thousand tons, refined value*)	
(i) Gross Imports	225	
(ii) Gross Exports (exports to Saar and re-exports to other destinations)	75	
	150 metric tons (165 metric tons, raw value).	
Estimated requirements from free market		165
Carried forward		1,290

[1] *I.S.C. Stat. Bull.*, 1959, **18**, (12), 92–94.

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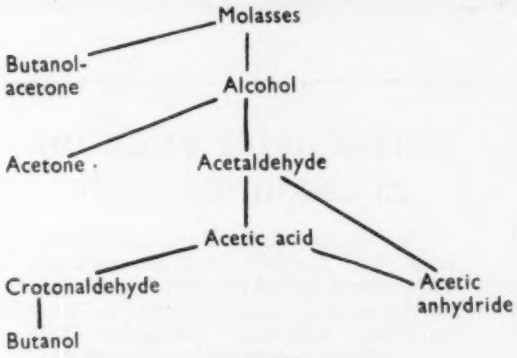

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Brought forward		1,290
COUNTRY OR AREA—		
EUROPE (excluding United Kingdom and France)—		
Austria	5	
Belgo-Luxembourg Economic Union	40	
Eire	40	
Finland	160	
Germany (West)	200	
Greece	110	
Iceland	10	
Netherlands	110	
Norway	150	
Sweden	45	
Switzerland	225	
Yugoslavia	65	
		1,160
AMERICA—		
Bolivia	50	
Chile	200	
Colombia	10	
Honduras	10	
Uruguay	110	
Venezuela	85	
		465
AFRICA (other than British Commonwealth Countries and French Overseas Departments and Territories)—		
Canary Islands	10	
Libya	20	
Morocco	360	
Sudan	110	
Tunisia	75	
United Arab Republic (Southern Region)	30	
		605
ASIA (other than British Commonwealth Countries)—		
Afghanistan	30	
Burma	20	
Cambodia	10	
China (Mainland)	175	
Iran	260	
Iraq	165	
Israel	50	
Japan	1,000	
Jordan	50	
Korea (South)	70	
Laos	5	
Lebanon	35	
Mongolia	5	
Saudi Arabia and neighbouring Red Sea Territories	80	
Thailand	5	
United Arab Republic (Syrian Region)	55	
Vietnam	50	
OCEANIA (excluding New Zealand, Western Samoa and other French Overseas Territories)—		
Polynesia and Micronesia	5	
		2,070
		5,590
Allowance (2 per cent) for possible underestimates, supplies for ships' stores, and the unexplained disappearance of sugar.		110
		5,700

New Factory for Malaya[1].—Two Japanese firms intend to erect a sugar factory in the province of Wellesley with an annual producing capacity of 120,000 tons.

* * *

West Indies Sugar Corporation Liquidation[2].—The West Indies Sugar Corporation, a U.S. company operating in Cuba, will go into liquidation if stockholders approve the Directors' recommendations. It is believed that the Directors' action is the result of the Company's difficulties in attempting to operate under the present Cuban Government.

Sugar and Bagasse Paper Factory in China[3].—According to the East German news agency ADN a new sugar factory has been put into operation at Changchow in the South-east of the Chinese mainland. The plant, half of which has been completed, has a present processing capacity of 2000 tons of cane per day. The sugar factory is connected with a paper factory, the raw material for which is delivered by the sugar factory.

[1] F. O. LICHT, *International Sugar Report*, 1960, **92**, (Supp. 1), 10.
[2] *Public Ledger*, 9th January 1960.
[3] F. O. LICHT, *International Sugar Report*, 1960, **92** (Supp. 1), 9.

Taiwan Sugar Exports, 1956-1958[1]

Destination :	1958	1957	1956
	(*Metric tons, raw value*)		
AFRICA:			
British East Africa	—	23,115	23,754
Sudan	17,896	39,001	36,344
Total Africa	17,896	62,116	60,098
ASIA:			
Aden	15,472	26,700	17,683
British North Borneo	15,403	8,309	19,398
Burma	—	—	6,338
Ceylon	20,746	34,492	45,551
Hong Kong	22,411	48,931	32,297
Iran	195,957	115,979	136,845
Iraq	54,404	55,551	40,212
Japan	277,464	329,644	191,934
Korea (South)	22,747	13,580	17,561
Malaya	58,053	87,721	104,844
Pakistan	39,462	20,719	20,878
Thailand	19,781	4,261	13,315
Viet-Nam & Cambodia ..	23,730	40,318	22,228
Total Asia	765,630	789,385	669,084
OTHER COUNTRIES	5,675	5,805	3,664
GRAND TOTAL	789,201	857,306	732,846

Stock Exchange Quotations

CLOSING MIDDLE

London Stocks (*at 15th January*, 1960)

Anglo-Ceylon (5s)	19/10½
Antigua Sugar Factory (£1)	18/–
Booker Bros. (10s)	32/3
British Sugar Corp. Ltd. (£1)	28/1½
Caroni Ord. (2s)	4/9
Caroni 6% Cum. Pref. (£1)	19/–
Distillers Co. Ltd. (6s. 8d. units)	37/9
Gledhow Chaka's Kraal (£1)	62/3
Hulett & Sons (£1)	73/9
Jamaica Sugar Estates Ltd. (5s units) ..	9/4½
Leach's Argentine (10s units)	17/–
Reynolds Bros. (£1)	60/6
St. Kitts (London) Ltd. (£1)	67/6
Ste. Madeleine (Ord.) (£1)	28/9
Sena Sugar Estates Ltd. (10s)	21/9
Tate & Lyle Ltd. (£1)	62/–
Tate & Lyle Investments Ltd. (5s)	16/6
Trinidad Sugar (5s stock units)	32/6
United Molasses (10s stock units)	69/6
West Indies Sugar Co. Ltd. (£1)	21/9

CLOSING MIDDLE

New York Stocks (*at 14th January*, 1960)	$
American Crystal ($10)	39½
Amer. Sugar Ref. Co. ($100)	29½
Central Aguirre ($5)	25¾
Cuban American ($10)	17½
Great Western Sugar Co.	29¼
South P.R. Sugar Co.	20½
United Fruit Co.	29¼
West Indies Sugar Corp. ($1)	39½

BREVITIES

The Moroccan sugar industry[2].—Morocco is the country with the highest per caput consumption in North Africa. From 100,000 tons in 1927 consumption has grown to over 328,000 tons in 1958 and may be expected to have risen to 360,000 tons, raw value, in 1959. Between the two world wars, Cuban sugar was refined in France and exported to Morocco as loaf sugar. Just after the war, sugar supplied was entirely from the franc zone. When Morocco became independent she arranged direct importations but France remained her principal supplier under annual agreements over 1953/56 and under a three-year agreement for 1956/59. There are two refineries in Casablanca: that of Cie. Sucrière Marocaine, of 250,000 tons/year capacity, and that of Omnium Industriel du Moghreb, of 25,000 tons/year capacity. The refinery of Borras, in Tetuan, has a capacity of 5–6000 tons/year. Cultivation of sugar beets is also being investigated.

* * *

Brazil Sugar Exports.—Since the quotas under the International Sugar Agreement were announced, Brazil has sold 420,000 tons of sugar for delivery in 1960. This is only 60,000 tons less than the whole of her provisional quota and the sale of such a large proportion in the first fortnight has led to speculation as to whether she will remain a member of the Agreement (she has not yet signed it). The *Financial Times*[3] points out that it does not necessarily imply that Brazil has given up the idea of adhering to the Agreement since it is easier for her to sell her sugar early in the season than for some other producers; it will be more useful to be able to point to contracts for sale than to an unsold crop when asking for International Bank loans (which Brazil may well have to do some time next year), and also, if Brazil can sell all her quota, she would not be affected by any quota reductions which may be possible in early 1960.

* * *

Northern Rhodesia Refinery[4].—The £1¼ million sugar refinery built at Ndola is expected to go into production early this year and it is hoped that full production at the rate of 20,000 tons of sugar a year will be achieved in April or May.

* * *

British beet sugar factories for U.S.S.R.—A contract for the supply of two complete beet sugar factories for the U.S.S.R. was signed on 29th December by representatives of Techmashimport of Moscow and by Vickers and Bookers Ltd., the joint company recently formed for developing sales and supply of machinery for beet sugar factories to the U.S.S.R., China and other Eastern European and Far Eastern countries. The value of this order, which has been under negotiation for a year, is of the order of £8 million and follows the contract secured earlier[5] by Vickers and Bookers for beet sugar unit equipment to the Soviet Union.

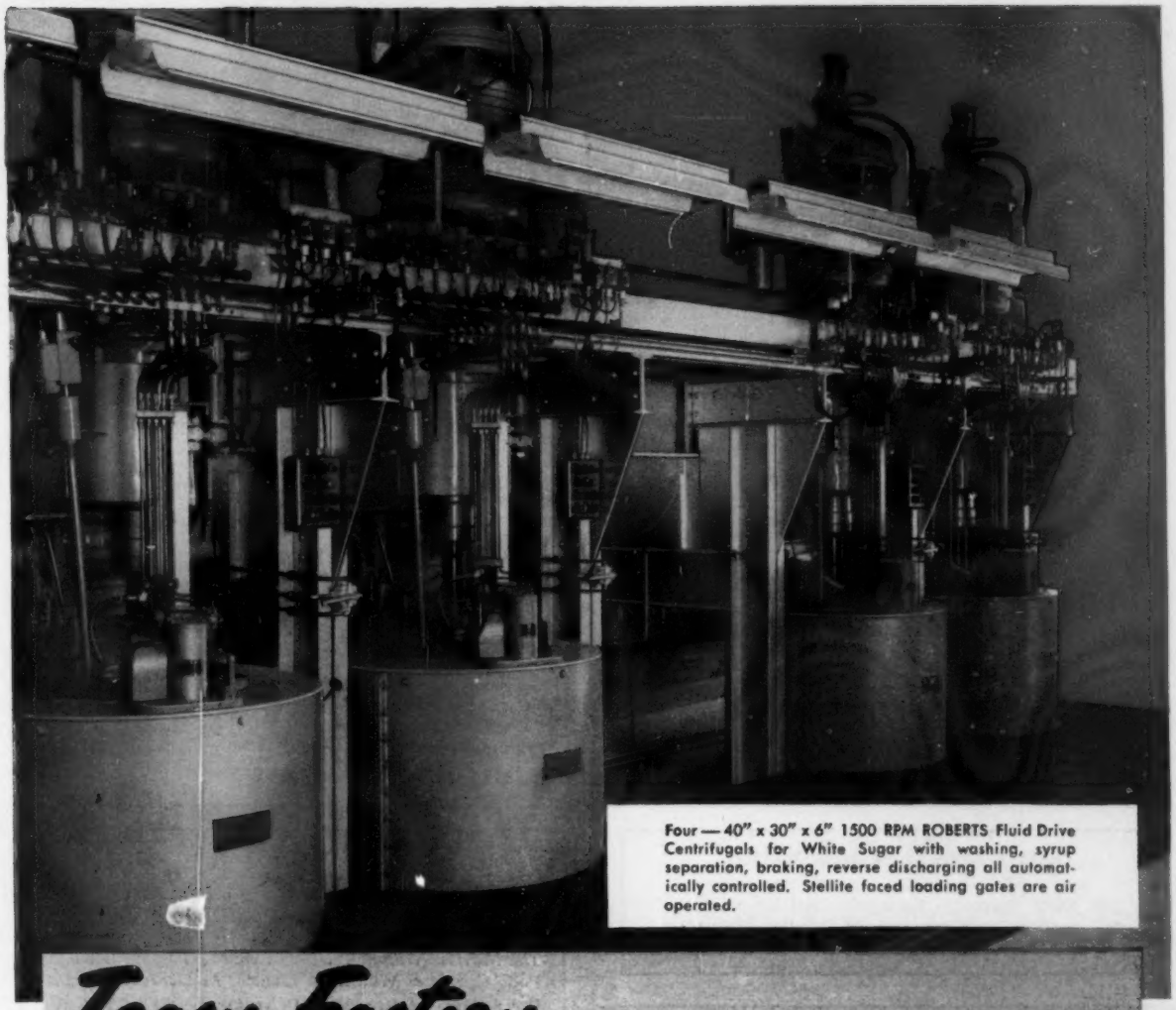
This new order calls for the supply of two factories, one in the Moscow region and the other in the Ukraine. Each of the two factories is to have a daily capacity of 5000 tons of beet and will be designed to incorporate the latest ideas on process automation.

In June Bookers Engineering Group negotiated Soviet orders for over £1½ million of unit equipment for beet sugar factories on behalf of their subsidiaries George Fletcher & Co. Ltd. of Derby and Duncan Stewart and Co. Ltd. of Glasgow, both of which have had long experience in the manufacture and supply of sugar machinery.

Duncan Stewart, who have played an important part in the development of the beet sugar industry in Great Britain, will be acting as the technical division of Vickers and Bookers Ltd. Several works in the Vickers Group of Companies and also George Fletcher in the Bookers Group will be engaged in considerable manufacture for the new contract.

---

[1] *Lamborn*, 1959, **37**, 226.
[2] *Bull. CEDUS*, 1959, (7), 10.
[3] 15th December 1959.
[4] *Overseas Review* (Barclays Bank D.C.O.), January 1960, p.29.
[5] *I.S.J.*, 1960, **62**, 28.



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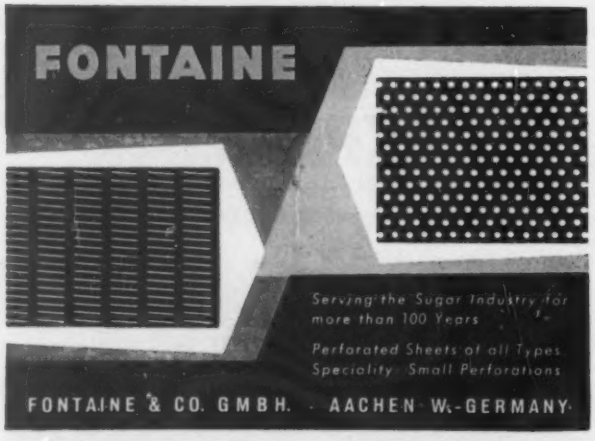
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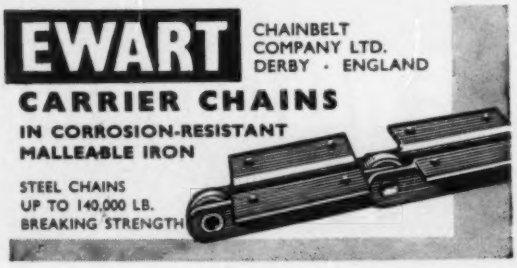

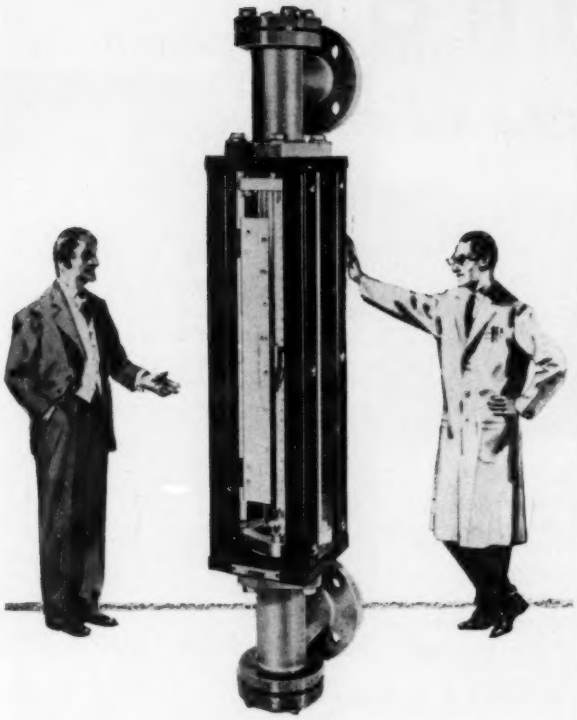

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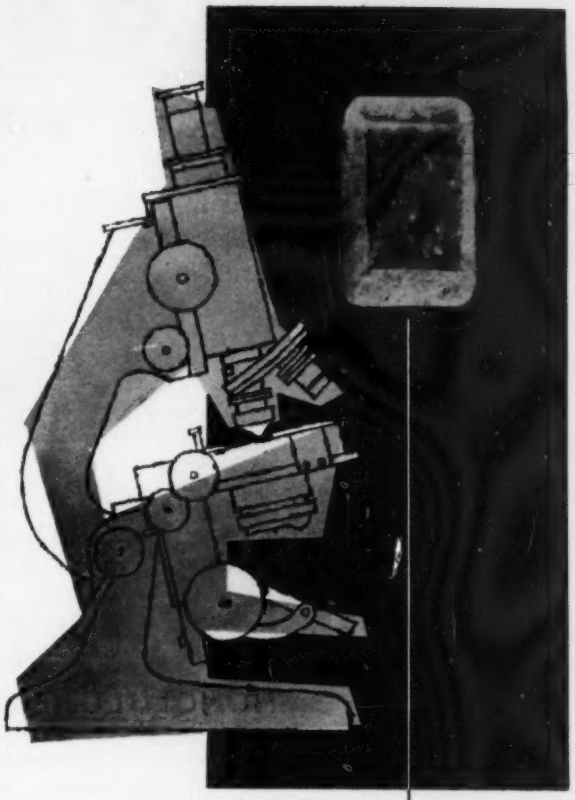

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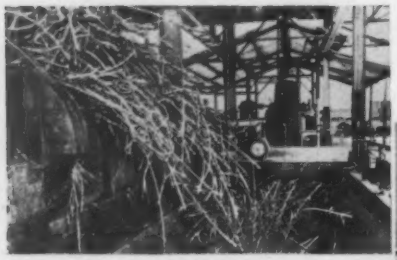

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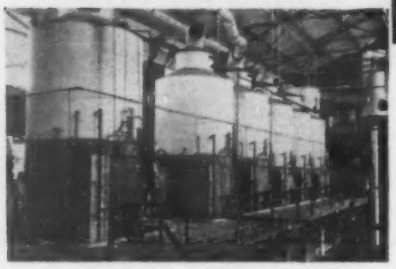

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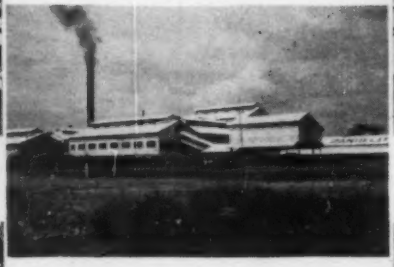

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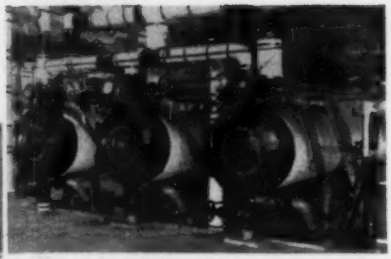

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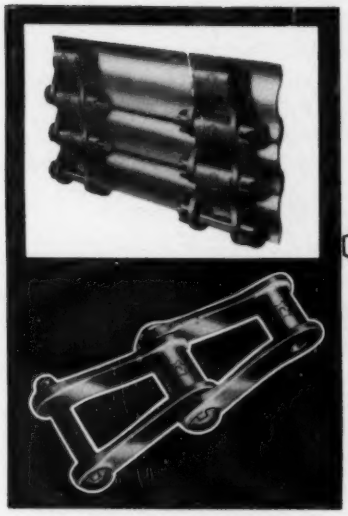

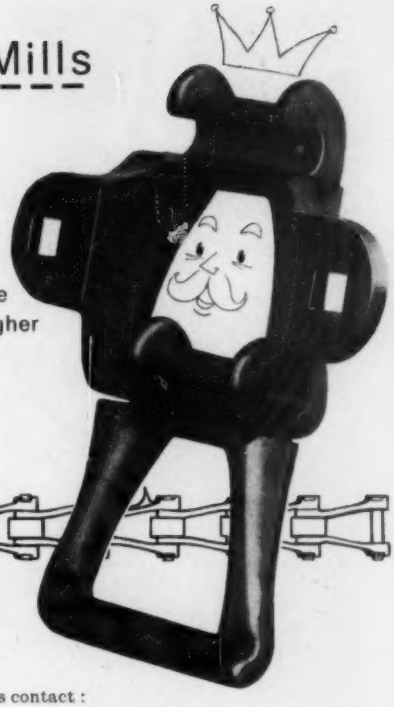

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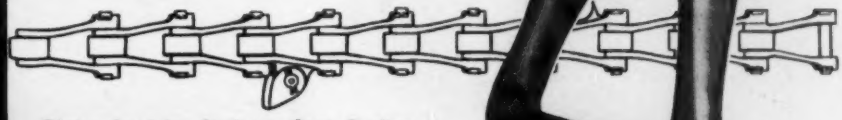

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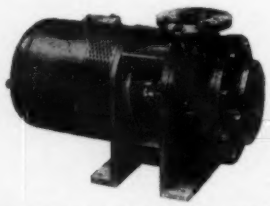

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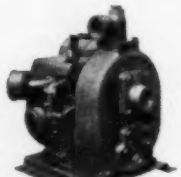

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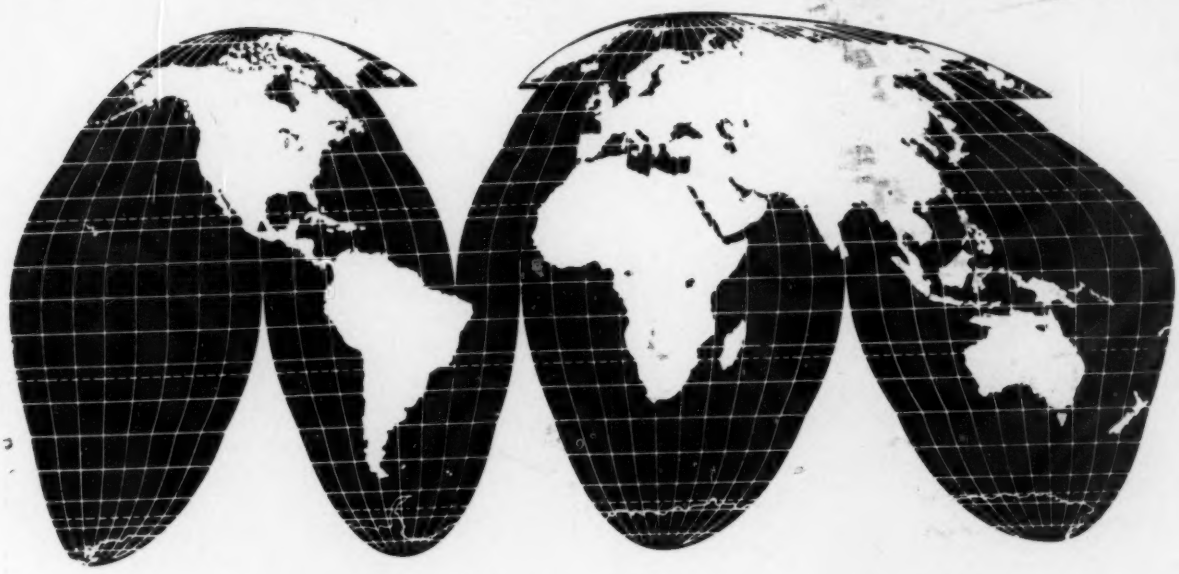

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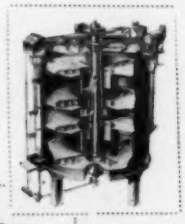

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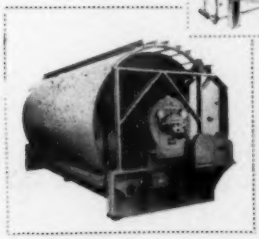

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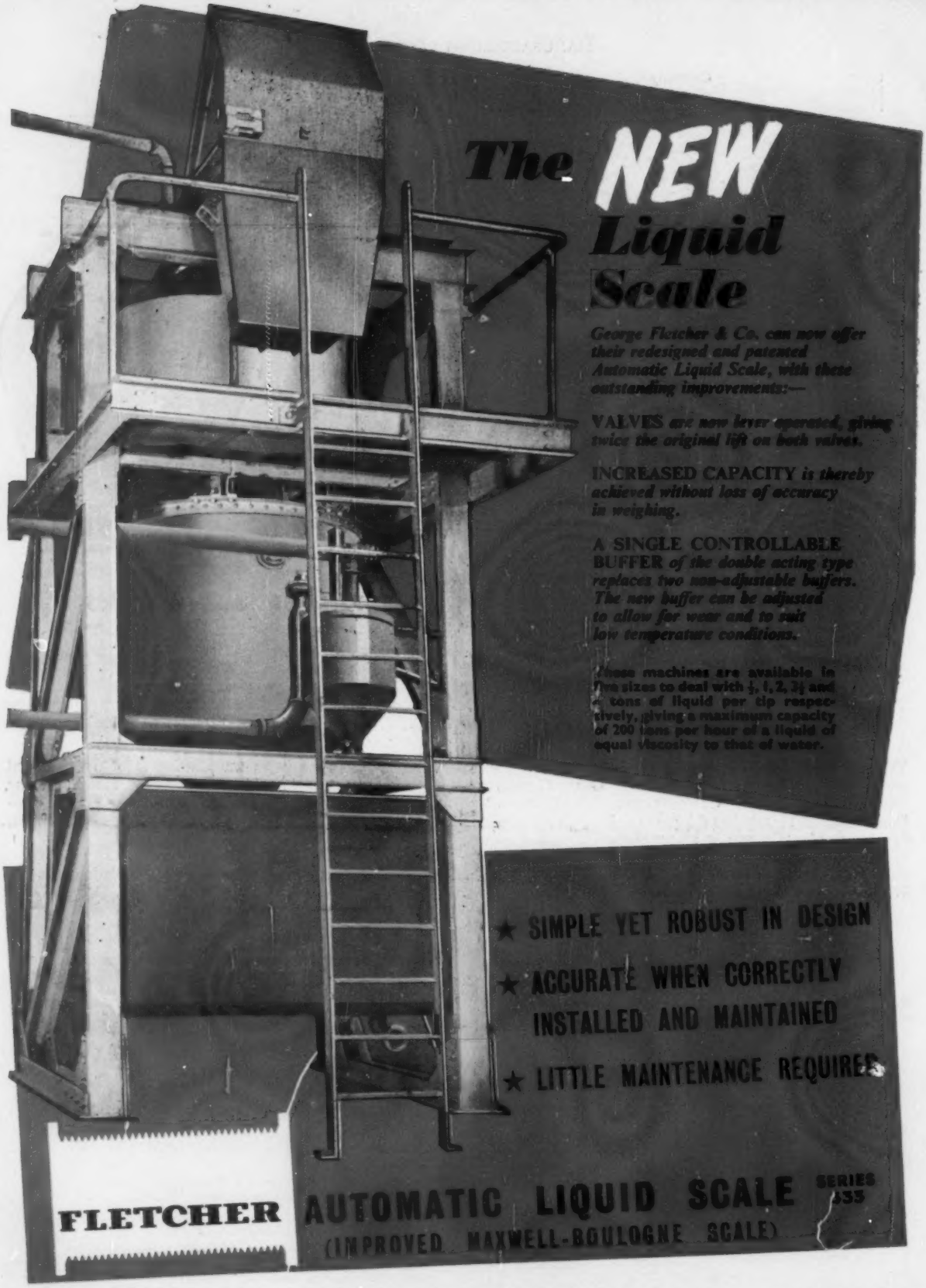
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